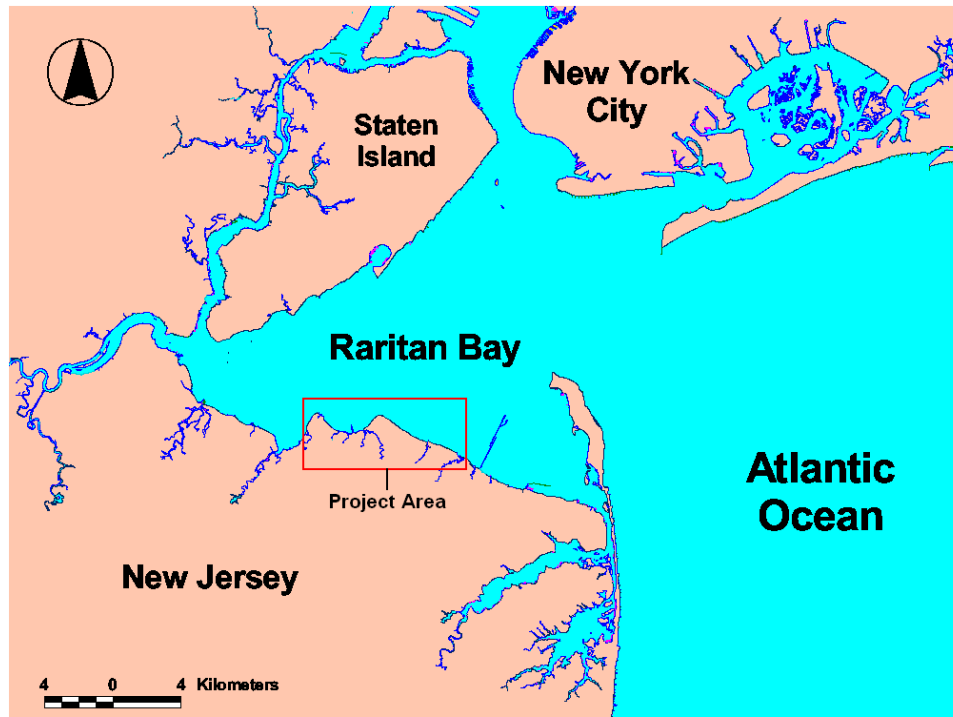


MONITORING OF INTERTIDAL BENTHOS ON THE SHORELINE OF RARITAN AND SANDY HOOK BAYS, NEW JERSEY: INTERIM REPORT



A Report to the U.S. Army Engineer District, New York

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INTRODUCTION

The U.S. Army Corps of Engineers, New York District (USACE) is presently engaged in a series of erosion control projects to protect beaches along the shorelines of Sandy Hook Bay and southern Raritan Bay, New Jersey (Figure 1). Concern over potential ecological impacts due to dredging and filling operations focus on infaunal macroinvertebrates, a major source of forage for commercially and ecologically important coastal fishes and invertebrates. Impacts from beach nourishment are typically confined to the sand borrow sites and beach fill areas and may include reduced abundance or altered community structure of infauna, altered feeding habits among fish and invertebrates, and increased turbidity (National Research Council, 1995).

A study to examine the distribution of infauna and seineable fish inhabiting the intertidal zone of three beaches along the south shore of Raritan and Sandy Hook Bays to be nourished was initiated in September 2002 (Figure 2). In this report, information gathered from the infaunal portion of the study is presented: data generated from examinations of seine collections and fish feeding habits will be provided in a separate report (Ray 2004, in prep.).

Most studies of Raritan Bay infauna have focused on open-bay waters (e.g., Dean, 1975; Dean and Haskin, 1960; Cerrato et al., 1989; Steimle and Carracciolo-Ward, 1989). Only four studies describe the bay's intertidal sediments and fauna: Simeone (1977), Ettinger (1998), and Ray (2000a and b). In November of 1975 Simeone (1977) sampled intertidal infauna at six locations along Sandy Hook Bay. In 1994 Ettinger (1996) sampled three tide levels, ranging from Mean Low Water (MLW) to approximately MLW-1m, at nine stations on Port Monmouth Beach (Belford Harbor to Pews Creek), 20 stations on Keansburg Beach (Pews Creek to Point Comfort), and 7 stations at Point Comfort (between the point and Waacaack Creek). These sites and an additional 5 at Lawrence Harbor were sampled again in 1995. Ray (2000a) sampled MLW and MLW-1m stations at 12 locations along both Cliffwood Beach and the eastward facing portion of Union Beach (Conaskonk Point to Chinngarora Creek) in June and September of 1999. Twelve sites along Union Beach (Flat Creek to Conaskonk Point) were also sampled in September 1999 (Ray, 2000b).

Based on these studies, sediments were found to vary widely along the shoreline ranging from fine sands at Sandy Hook Bay to gravelly medium and coarse sands at Union Beach. Dominant infauna encountered in the various studies included softshell clams (*Mya arenaria*), gem clams (*Gemma gemma*), a variety of euryhaline soft-sediment polychaetes (e.g., *Leitoscoloplos fragilis* and *Heteromastus filiformis*) and amphipods (e.g., *Gammarus lawrencianus*).

Information presented in this report represents the baseline or "before" dataset for an analysis of environmental impacts. Analysis of Variance using a Before/After-Control/Impact (BACI) design will be employed in the final environmental impact evaluation. BACI is a common study design for detecting environmental impacts: comparisons are made between both a control and an impact site, before and after an

event, in this case beach nourishment (Hewitt et al. 2001). The presence of an impact is usually distinguished by a statistically significant interaction term. In this study, we are interested in detecting differences in the mean abundance and biomass between reference and potential nourishment sites.

METHODS

Field Sampling and Laboratory Analyses

Sampling was conducted at ten stations within each of three stretches of beach along the south shore of Raritan Bay and Sandy Hook Bay (Figure 2). In addition to beaches at Port Monmouth, Keansburg, and Union Beach a short stretch of beach near Point Comfort was also monitored. Samples were taken at two depths, Mean Low Water (MLW) and MLW-1m at each station. A total of three 7.5 cm diameter – 10 cm deep cores were taken at each depth and the samples fixed in buffered 10% formalin. All samples were collected by Northern Ecological Associates, Inc. with assistance from personnel from the U.S. Army Corps Engineer Research Development Center, (ERDC) and US Army Engineer District, New York.

In the laboratory, samples were sieved (0.5 mm mesh) and material retained on the sieve stained with 1% Rose Bengal and stored in 70% ethanol. Subsequently samples were examined under 3X magnification and organisms sorted from the sediments. The organisms were then enumerated by LPIL (lowest practical identification level) taxa and wet-weight biomass determined after combining LPIL taxa into higher-order taxa. Barry Vittor and Associates processed the infaunal samples.

Since the three core samples taken at each station and depth during the different sample periods are essentially subsamples of that station, core data were pooled prior to statistical analysis. This yields a total sample area of 0.132 m² per station.

In addition to the three infaunal samples, another sediment core was taken at each station for determination of sediment grain size distribution. Sediments were placed in whirl-pac bags and transported to ERDC where they were analyzed using a combination of wet-sieving and flotation procedures (Folk, 1968; Galehouse, 1971). Grain size data analysis was conducted using Gradistat 4.0 (Blott, 2000), which calculates a variety of grain size parameters as well as the percentage of sediments in individual grain size categories. Grain size parameters and descriptions were based on the methods of Folk and Ward (1957).

Beginning in June of 2003 sediment samples were placed on ice immediately after collection and shipped frozen. Once at laboratory organic content was estimated by loss of weight upon ignition. In this procedure duplicate aliquots (~2 grams wet-weight) were dried at 100 °C for 12 hours and weighed after cooling in a drying chamber. The aliquots were then placed in a muffle furnace at 500 °C for 12 hours, allowed to cool once again in the drying chamber and reweighed. Organic content was calculated as percentage loss between aliquot ash-free and dry-weights.

Statistical Analyses

Community species composition was analyzed by Non-Metric Dimensional Scaling (MDS) followed by Analysis of Similarity (ANOSIM) using PRIMER software. All species were included in the analysis and abundances were \log_{10} transformed prior to calculations. Analysis of Variance (ANOVA) was performed using a nested model comparing areas (Port Monmouth, Keansburg, Point Comfort, and Union Beach.) by date (Sept. 2002, June 2003, and Sept. 2003) with depth (MLW and MLW-1m) nested within area. All data were examined for normality prior to testing and transformed where necessary. Sediment mean grain size and sorting coefficient values were 4th-root (X^{-4}) transformed, sediment organic content, and total biomass were square root transformed, and abundance was $\log_{10}(X+1)$ transformed. Where significant differences ($p < 0.05$) were encountered in the ANOVA a Tukey-Kramer Highly Significant Difference (HSD) test was performed on the effect means.

RESULTS

Physicochemical Variables

The physical and chemical environment of the study sites appears to be relatively uniform (Table 1). Values for temperature, salinity, dissolved oxygen concentration, dissolved oxygen percent saturation, turbidity, and pH are relatively consistent within the project area on any given sample date. Where differences occur they are primarily between sample dates and reflect either normal seasonal variations or specific weather events. For instance, salinities were the lowest in June 2003 reflecting the higher runoff typical of this time of year. while Elevated dissolved oxygen, percent saturation, and turbidity values occurring in September 2003 were likely due to several days of strong on-shore winds.

Sediments

Sediments in the project area ranged from gravelly mud to sandy gravel and were either poorly or very poorly sorted (Appendix Table 1). ANOVA comparisons of sediment grain size detected significant differences ($p < 0.05$) among areas, depths within areas, and date (Table 2). Mean grain size (MGS) ranged between 300 μm and 400 μm (medium sand) at Keansburg and Union Beach to approximately 600 μm (coarse sand) at Port Monmouth and over 800 μm (coarse sand) at Point Comfort (Figure 3). MGS was also significantly greater ($p < 0.05$) in September 2002 and June 2003 than September 2003 (Figure 4). The average grain size was greater at Mean Low Water (MLW) than at MLW-1m stations (Figure 5). There were no significant differences ($p > 0.05$) between depths within each area over time (Table 2; Figure 7).

Sorting coefficient values, a measure of variability in grain size distributions within a sample, were highest at Port Monmouth and lowest at Keansburg (Figure 3). All mean values fell in the range of poorly to very poorly sorted sediments (Folk and Ward, 1957). Sorting coefficient values were significantly higher ($p < 0.05$) in September 2003

than either of the prior dates (Figure 4). There were no distinct differences among depths within areas (Figure 5) or between depths within each area over time (Figure 8; Appendix Table 3).

Organic content was significantly different ($p < 0.05$) among areas, dates, areas over time, and depths within areas over time, but not among depths within areas (Table 2). Organic content was generally low, averaging slightly less than 1% at Keansburg and Port Monmouth to approximately 2% at Point Comfort and Union Beach (Figure 3). There was a slight but statistically significant ($p < 0.05$) drop in organic content between June 2003 and September 2003 (Figure 4), which appears to have been driven by a decrease at Point Comfort (Figure 6) and occurred at both sampling depths (Figure 9).

Distributions of individual sediment grain size fractions are plotted in Figures 10-12 for September 2002, June 2003 and September 2003 respectively. During each of the sample periods sediments were predominately medium and coarse sands with coarser fractions being more dominant at MLW. The proportion of fine and very fine sand fractions and silts and clays were far greater in MLW-1m sediments. Gravel, coarse sands and very coarse sands were found in the greatest abundance at MLW at Keansburg, although they also were important components of MLW sediments at Port Monmouth.

Benthic Macroinvertebrates

A grand total of 155 taxa and over 42,000 animals were collected during the first three sampling periods; dominant taxa included the gem clam, *Gemma gemma*, which made up 53% of all animals, and the spionid polychaetes *Streblospio benedicti* and *Polydora cornuta* which each accounted for approximately 6% of all animals (Table 3). The oligochaete family Tubificidae and the tubificid species *Tubificoides heterochaetus* together made up an additional 10% of the total collection, while specimens identifiable only to the level of Oligochaeta constituted nearly 3%. Ribbon worms (Rhynchocoela) and the sabellariid polychaete *Sabellaria vulgaris* also supplied more than 2% of the total number of animals. Taxa making up approximately 1% of the collection included the snail *Ilyanassa* (= *Nassarius*) *obsoletus*, the polychaetes *Mediomastus* (LPIL), *Heteromastus filiformis*, *Streptosyllis pettiboneae*, and *Protodriloides* (LPIL).

Gemma gemma was the most abundant species overall and was particularly numerous at MLW-1m (Table 4). Other taxa abundant at MLW-1m included *S. benedicti*, Tubificidae (LPIL), *T. heterochaetus*, *I. obsoleta*, *Mediomastus* (LPIL), *H. filiformis*, and *S. pettiboneae*. The taxa most abundant at MLW were Rhynchocoela (LPIL), Oligochaeta (LPIL), *P. cornuta*, *S. vulgaris*, *Protodriloides* (LPIL), *Paraonis fulgens*, *Microphthamalus* (LPIL), and *Polygordius* (LPIL).

In terms of abundance, *Gemma gemma* was the overwhelmingly dominant taxon at Port Monmouth; no one species achieved the same level of dominance at any of the remaining areas (Table 4). *Streblospio benedicti* constituted the largest proportion of animals at Keansburg making up 16.9% of all animals; *P. cornuta* and *G. gemma* were the second and third most numerous taxa, respectively. Tubificidae (LPIL) contributed

the largest number of animals at Point Comfort (19%), while *S. benedicti* and Rhynchocoela were the next most abundant taxa. Union Beach was dominated by *T. heterochaetus* (13.5%), Tubificidae (12.5%) and *G. gemma* (12.2%). None of the dominant taxa occurred exclusively at one area, and *Protodriloides* (LPIL) was found only at MLW.

Comparison of species composition by Nonmetric Dimensional Scaling (MDS) and Analysis of Similarity (ANOSIM) indicated relatively few differences among sites or depths. In September 2002 all three sites were very similar with only a few individual stations being outliers (Figure 13). The results of the ANOSIM tests on the September 2002 data (Table 5) support this interpretation with *r*-values (a significance test) not being significantly different ($r < 0.67$) for any of the global tests (Area, Depth or Depth X Area). Close examination of the September 2002 MDS plot does give a hint of differences between MLW and MLW-1m samples, but this pattern does not become apparent until the 2003 samples are examined.

In June 2003 a number of the MLW samples (particularly Point Comfort and Keansburg) were not closely aligned with the remaining samples (Figure 14). Stress, a measure of goodness of fit (values > 0.2 indicate poor fit), was high (stress = 0.18) and ANOSIM did not detect any global differences among areas or depths. Nonetheless, there were significant ($r > 0.67$) differences between pairwise comparisons of Keansburg and Point Comfort MLW and MLW-1m samples (Table 5). The September 2003 MDS (Figure 15) and accompanying ANOSIM tests (Table 5) were similar to the September 2002 results in that no pattern of differences was detected between areas or depths within areas. Some differences occurred in the area by depth pairwise comparisons, however these occurred between disparate pairs of samples (e.g., Point Comfort MLW was different than Union Beach MLW-1).

Analysis of Variance (ANOVA) of total numerical abundance (total number of animals/m²) indicated significant differences ($p < 0.05$) between areas, depths within areas, and areas over time, but not between dates or depths within areas over time (Table 2). Total abundance was higher at Port Monmouth and Keansburg than Point Comfort and Union Beach (Figure 16); it was also higher at MLW-1m than MLW at both Port Monmouth and Union Beach (Figure 17). Abundance also varied among areas over time (Area X Date interaction), but only September 2003 abundances were significantly different ($p < 0.05$). Abundances at Keansburg were higher than those of Point Comfort and Union Beach (Figure 18).

Biomass differed significantly ($p < 0.05$) among areas, depths within areas and depths within areas over time (Table 2). Biomass was highest at Union Beach and lowest at Point Comfort. Biomass at MLW-1m biomass was higher than MLW in all areas except Point Comfort (Figure 17). In June 2003 biomass was significantly higher ($p < 0.05$) at Union Beach than either Keansburg or Point Comfort, however there were no differences among areas in either of the other sample periods. Biomass also differed among depths within areas over time with MLW-1m values at Keansburg and Union Beach being greater than their respective MLW values in September 2002, while in June

2003 and September 2003 MLW-1m biomass values at both Port Monmouth and Union Beach were higher than those of the matching MLW stations (Figure 19).

Biomass composition varied among depths and areas over time. MLW-1m stations were generally dominated by mollusks (Figures 20-22) with the exception of Point Comfort where arthropods comprised as much as 50% of total biomass during September of both 2002 and 2003. Arthropods also dominated September MLW biomass at both Port Monmouth and Keansburg. During June 2003 mollusks were the major component of MLW biomass at both of these sites. Point Comfort biomass MLW biomass was dominated by miscellaneous taxa during the September sampling periods and by annelids in June 2003.

DISCUSSION

The Raritan Bay estuarine complex is a triangular shaped body of water bordered by Sandy Hook on the east, the shorelines of Middlesex and Monmouth counties (New Jersey) on the south, the Raritan Valley on the west, and Staten Island, New York on the north (Figure 1). It is comprised of Raritan Bay, Sandy Hook Bay, and Lower New York Harbor. Bay depths average less than 8 m outside of dredged channels and the bathymetry is relatively flat; the 12-foot (3.7 m) MLW contour is as far as a mile from the shoreline with the exception along the easternmost portion of the bay where depths are somewhat greater (USACE, 1960). Bay currents move in a counter clock-wise fashion typical of North American estuaries with major inward flows moving along northern shore and outbound flows moving along the southern shore; there may also be a large clock-wise gyre located between the Navy Pier (east of Port Monmouth Beach) and Point Comfort (Jeffries, 1962). The tidal range is slightly less than 2 m and flushing is sluggish, requiring between 32 and 42 tides (16-21 days) to completely replace bay waters (Ketchum, 1951).

The Raritan River provides almost all the freshwater to the system and its waters characteristically flow along the southern shoreline of the bay slightly lowering the salinity (~1 ppt) compared to the northern shoreline (Jeffries, 1962). Salinities range from mesohaline (~22 ppt) near the mouth of the Raritan River to polyhaline (32ppt) at Sandy Hook (Jeffries, 1962; Cerrato et al., 1989; and Steimle and Caracciola-Ward, 1989).

Water quality has varied considerably over the years especially with regard to levels of nutrients, dissolved oxygen concentrations and fecal coliform (bacteria) counts. Prior to the late 1950's raw sewage and many contaminants directly entered the bay creating a highly polluted condition (Jeffries, 1962). In 1958 a large trunk sewer went into operation providing primary treatment and removal of sludge from the system. This and other pollution-control efforts have resulted in significant improvement in overall water quality in Raritan Bay. Long-term monitoring of northern Raritan Bay waters by the New York City Department of Environmental Protection (NYDEP, 1997) indicates trends of continuing decrease in fecal coliform counts and increase in dissolved oxygen concentrations since the early 1970's.

Sediment distributions within the bay are variable, areas north of the Raritan Channel tend to be fine and very fine sands, while those to the south are typically muddy with occasional patches of fine and very fine sands (Cerrato et al., 1989; Steimle and Caracciola-Ward, 1989). Sediments of the shoreline itself vary widely. Simeone (1977) reported that fine sands dominated the beaches of Sandy Hook Bay; sites with the greatest exposure to wave action tend to be coarser than “protected” sites. Sediments from Port Monmouth to Union Beach range from muddy fine and very fine sands to medium and coarse sands (Ettinger, 1996). Ettinger (1996) also reported that sediments in the upper intertidal zone tend to be coarser grained than lower intertidal or subtidal sediments and that sediment grain size can change substantively over time. A change from muddy fine and very fine sands to medium and coarse sands occurring between 1994 and 1995 was attributed to a strong storm in 1995. Ray (2001a and b) reported gravelly fine and medium sands at both Union and Cliffwood Beaches during 1999. Sediments from Union Beach intertidal sites tended to be coarse to medium sands while medium to fine sands were prevalent at deeper sites. At Cliffwood Beach, intertidal sediments were actually slightly finer than subtidal sediments, however the portion of gravel was always higher in intertidal samples (Ray, 2001a). Shoreline sediments encountered in the present study are similar to those of the previous studies: sediments range from gravelly mud to sandy gravel with Keansburg and Union Beach dominated by medium sands and Port Monmouth and Point Comfort by coarse sands (Figure 3). Intertidal sediments were generally coarser than those of greater depth and as found by Ettinger (1996), there is an indication of inter-annual differences, (e.g., September 2003 sediments had lower mean grain size and greater proportions of silts and clays than either of the previous sample periods).

Dominant infauna of the study area are similar to those previously described for Raritan and Sandy Hook Bays (Simeone, 1977; Ettinger, 1996; Ray 2001a,b) and those of New England and Mid-Atlantic sand flats (e.g., Sanders, 1962; Whitlatch, 1977; Maurer and Aprill, 1979; Schull, 1997). The dominant taxa in all or most of these studies included the gem clam *Gemma gemma*, the soft clam *Mya arenaria*, the snail *Ilyanassa obsoleta*, the amphipods *Corophium* sp. and *Ampelisca abdita*, oligochaetes, and the polychaetes *Leitoscoloplos* (= *Haploscoloplos*) *fragilis*, *Heteromastus filiformis*, *Polydora cornuta*, *Streblospio benedicti*, *Streptosyllis verrilli*, and *Mediomastus ambiseta*. The relative dominance of individual taxa often varies with substrate type and tidal depth. Clean sands tend to be dominated by *G. gemma* and muddy sands by polychaetes (Whitlatch, 1977). Since sediment distribution often follows the intertidal gradient, *G. gemma* is often the most abundant taxon at MLW, while polychaetes are most abundant at lower depths.

The degree of wave exposure is also an important determinant in infaunal distribution; exposed sites tend to have fewer organisms and lower diversity than those sheltered from wave action (Simeone, 1977). Raritan Bay beaches are generally protected from ocean swells by Sandy Hook but are still susceptible to local wind events and strong storms coming from the direction of greatest fetch, i.e. north or northeast. Thus “northeasters” may result in increased wave action and erosion. Ettinger (1996)

attributes the large-scale changes in sediment composition and change in infaunal composition occurring between 1994 and 1995 to just such a strong storm. Less dramatic impacts resulting from predation, low winter temperatures, ice scouring, or other natural events can also give rise to substantial differences in abundance. For instance, following changes in intertidal species populations on North Sea tidal flats for ten years Dorjes et al. (1986) found that total abundance and numbers of individual species (e.g., *P. elegans*, *H. filiformis*, and *Tubificoides* sp.) could vary by as much as two orders of magnitude over time. Relative abundances (%) varied less but could still differ by an order of magnitude between years. In the present study total numbers of animals/m² differed by approximately 6-fold among areas but much of this difference can be attributed to a single species, *G. gemma*, a species known for its periodic peaks of abundance (Table 4 and Appendix Table 2).

Average total abundances within the study area ranged from a low of 2,681 animals/m² at Point Comfort to a high of 38,271 animals/m² at Port Monmouth. These values are similar to those from previous studies. For instance, Ettinger reported averages of 5,000-6,000 animals/m² for Port Monmouth and Keansburg. Ray (2001a and b) computed averages of 15,000-21,000 animals/m² for Union and Cliffwood Beaches. Biomass has only previously been reported for this area by Ettinger (1996) who found an average of 25.1 g/m² at Port Monmouth and 192.0 g/m² at Keansburg and was highest at subtidal depths (Table 6). Annelids dominated biomass at MLW and subtidal depths of Port Monmouth, while gastropods (principally *I. obsoleta*) made up most of biomass at mid-tide depths. At Keansburg, annelids and gastropods dominated upper- and mid-tide levels and bivalves comprised most of subtidal biomass. This same pattern is seen in the present study where annelids were the most important component of biomass at Port Monmouth and Keansburg MLW depths while bivalves constituted the majority of biomass elsewhere.

In conclusion, the sediments and infauna of the three study areas are similar to those previously reported for the Raritan and Sandy Hook Bay shoreline. Species composition, abundance, and biomass differ slightly among the three areas, between depths, and over time but all values are within the degree of variability that is typical of intertidal benthic communities. Data from further collections will be reported as it becomes available. A more detailed examination of the data will be conducted when the entire pre-construction sample collection becomes available.

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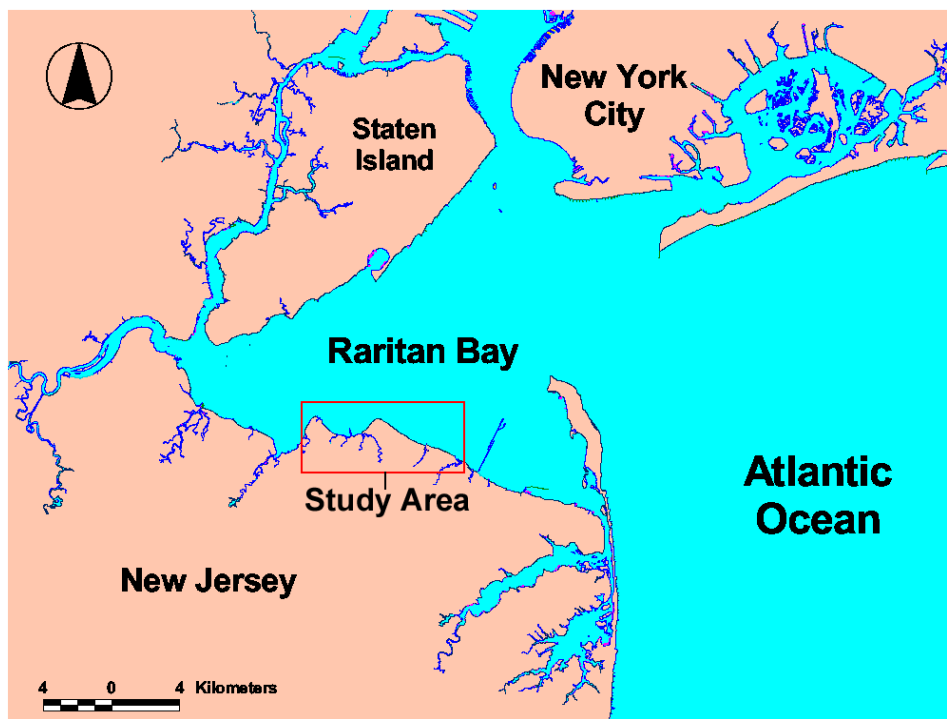


Figure 1. Study area and surrounding waters. Study site indicated by red box.

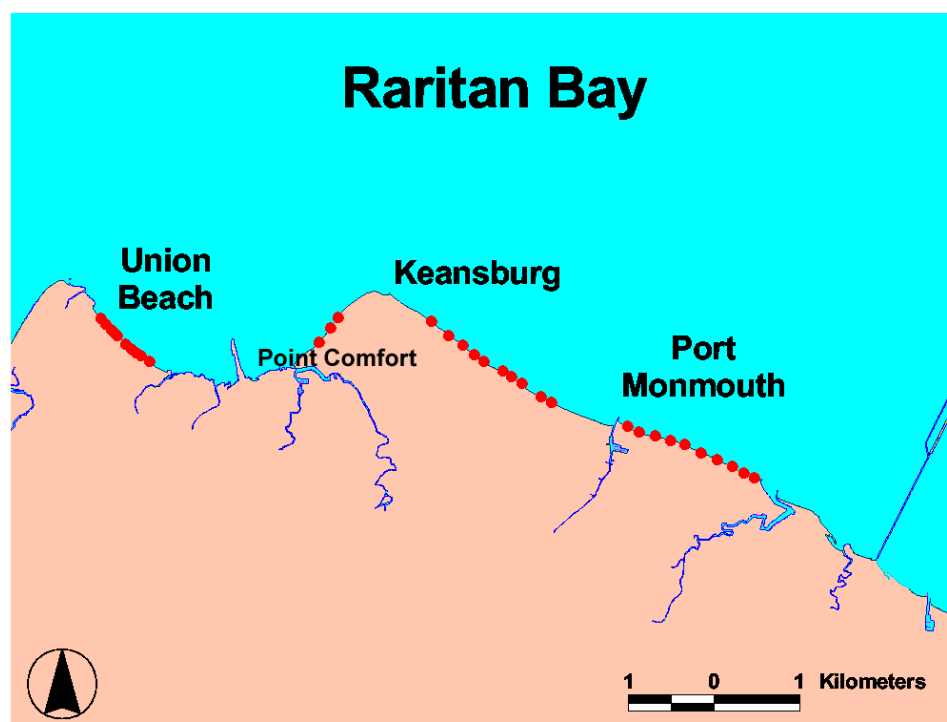


Figure 2. Study area and sampling sites. Individual sampling sites (stations) indicated as red dots.

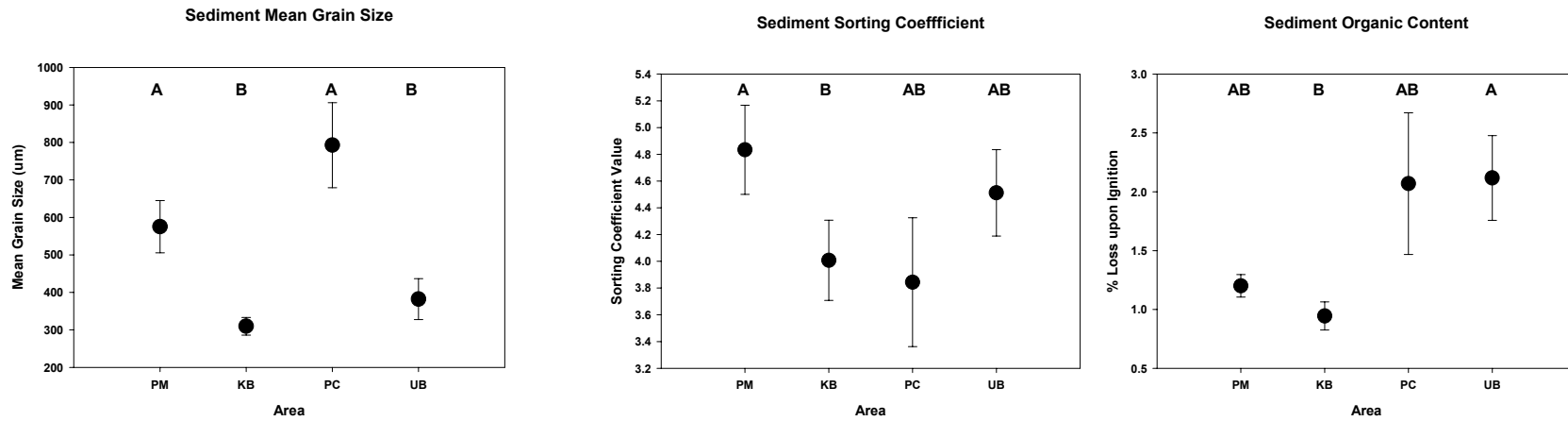


Figure 3. Sediment parameters by area. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

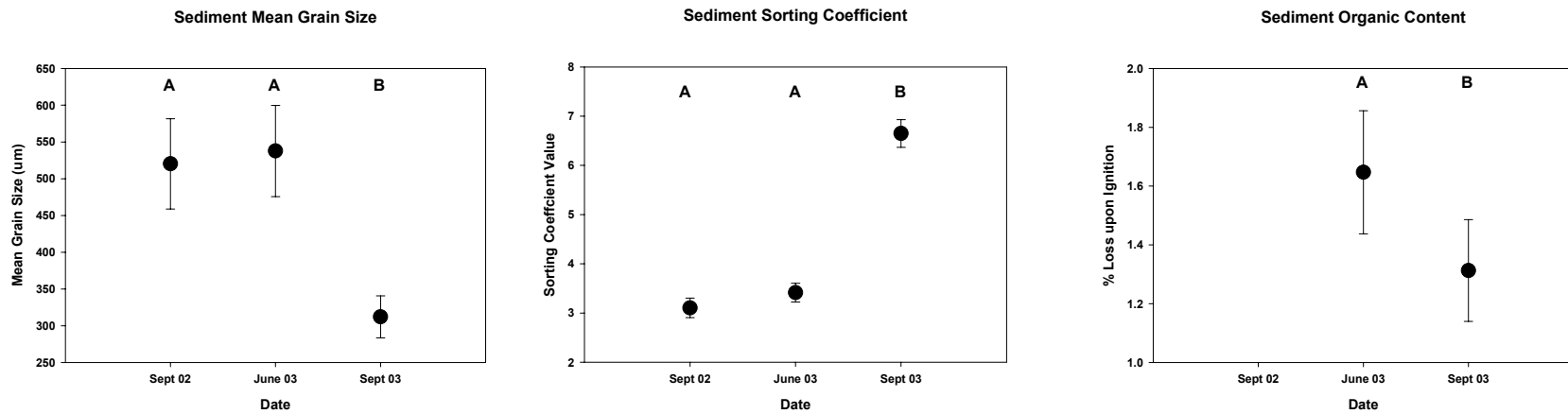


Figure 4. Sediment parameters by date. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

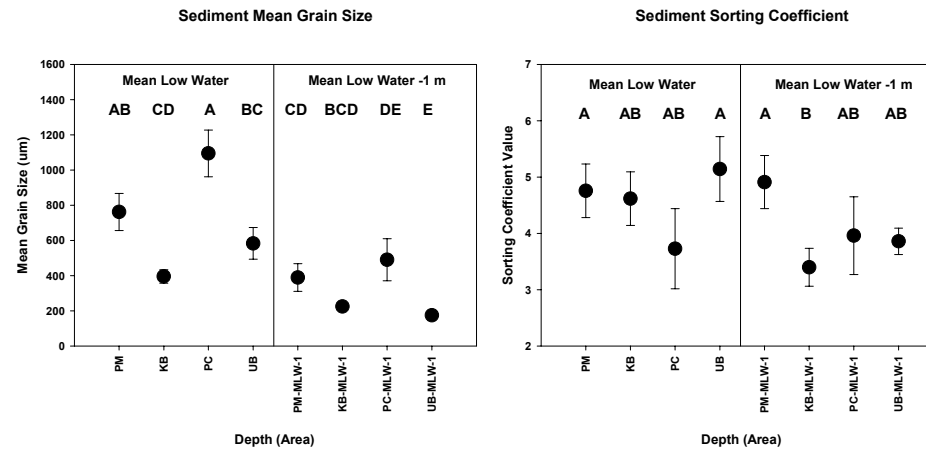


Figure 5. Sediment mean grain size and sorting coefficients by depth within area. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

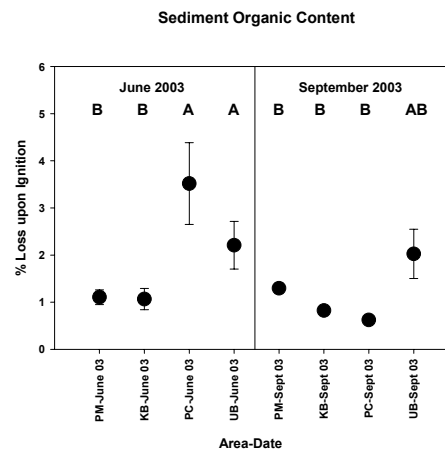


Figure 6. Sediment organic content by area and date. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

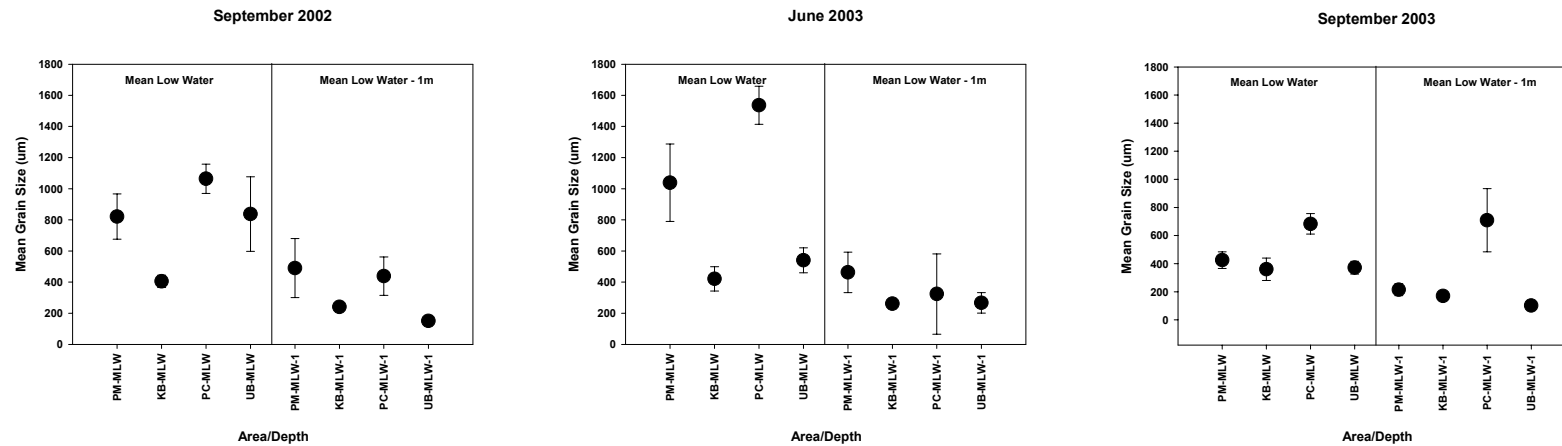


Figure 7. Sediment mean grain size by depth within area. Mean value in μm ($\pm\text{SE}$) by area and depth. Values with same letter are not significantly different ($p>0.05$)

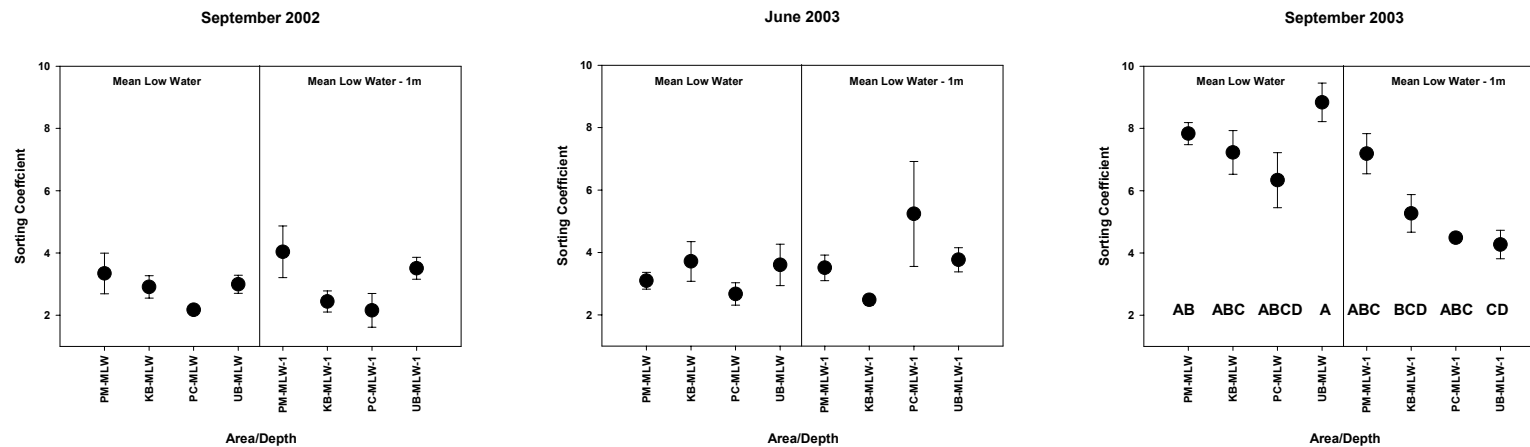


Figure 8. Sediment sorting coefficient values by depth within area. Mean value ($\pm\text{SE}$). Values with same letter are not significantly different ($p>0.05$)

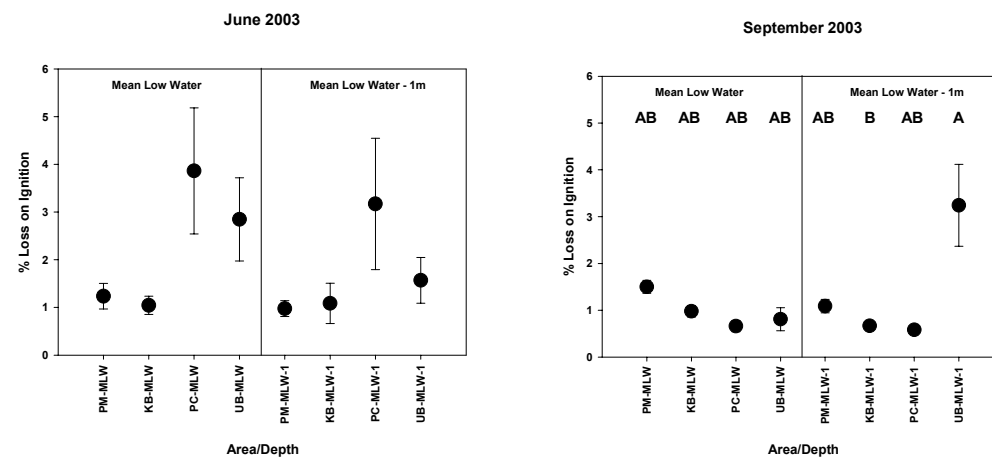


Figure 9. Sediment organic content by depth within area. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

September 2002

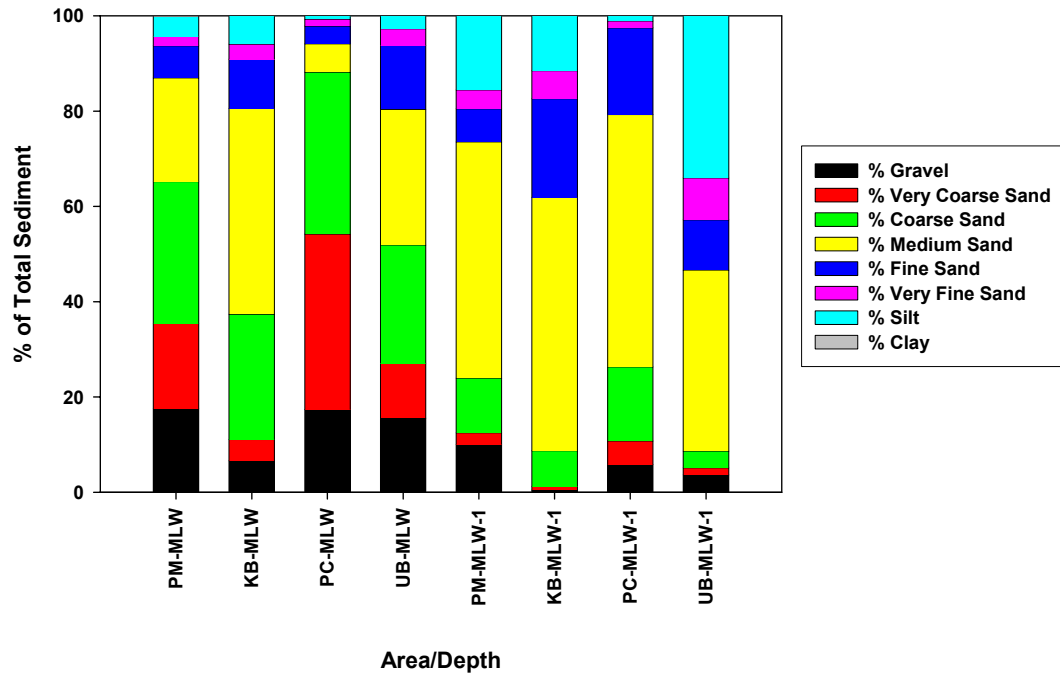


Figure 10. Sediment composition (% total by sediment fraction) for September 2002

June 2003

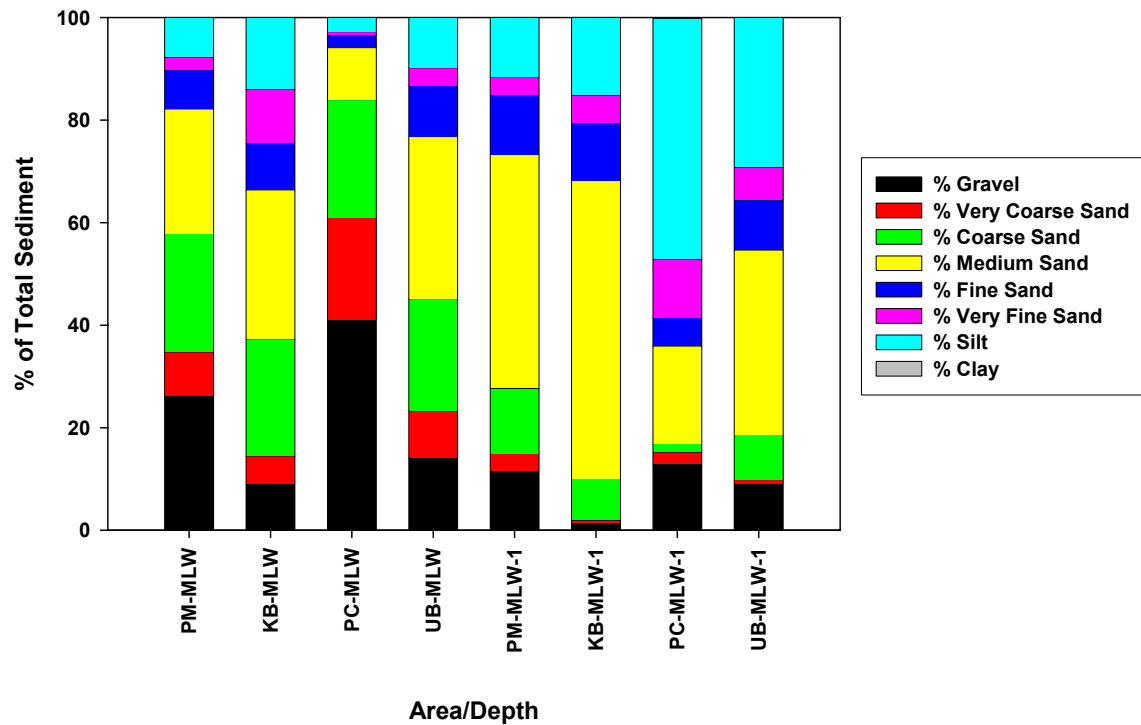


Figure 11. Sediment composition (% total by sediment fraction) for September 2002

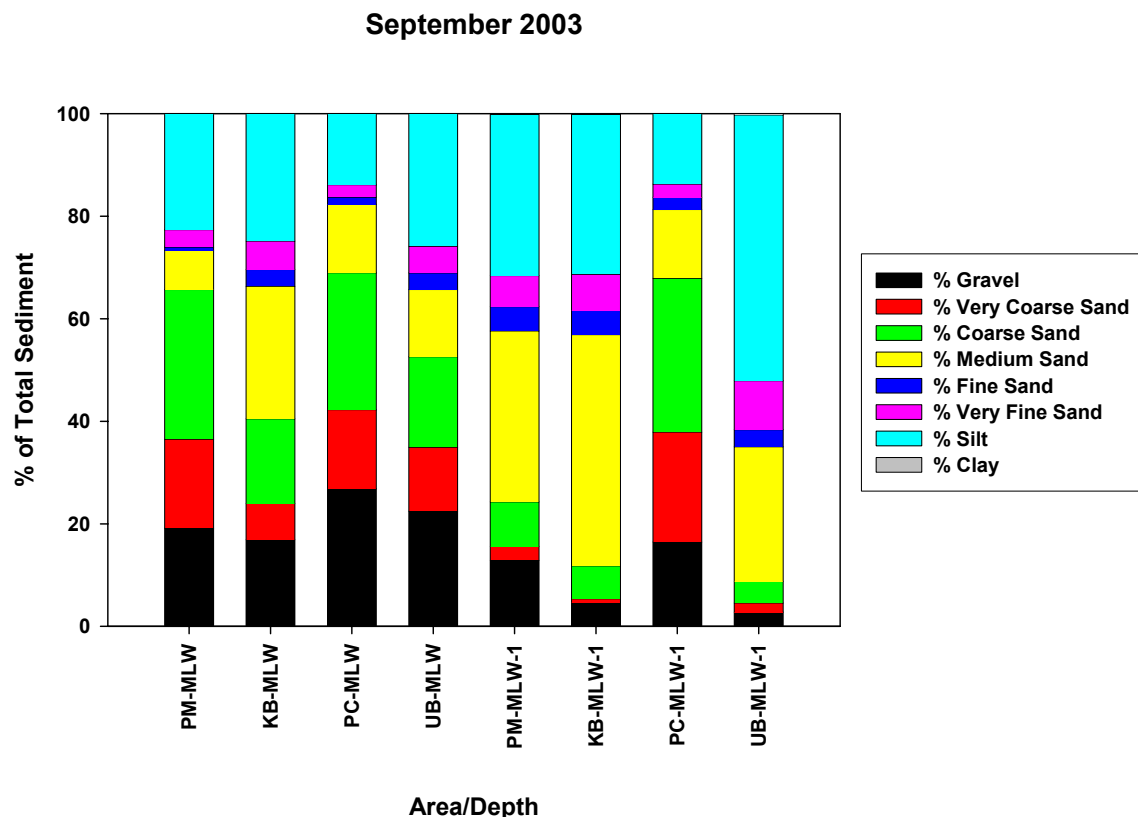


Figure 12. Sediment composition (% total by sediment fraction) for September 2003

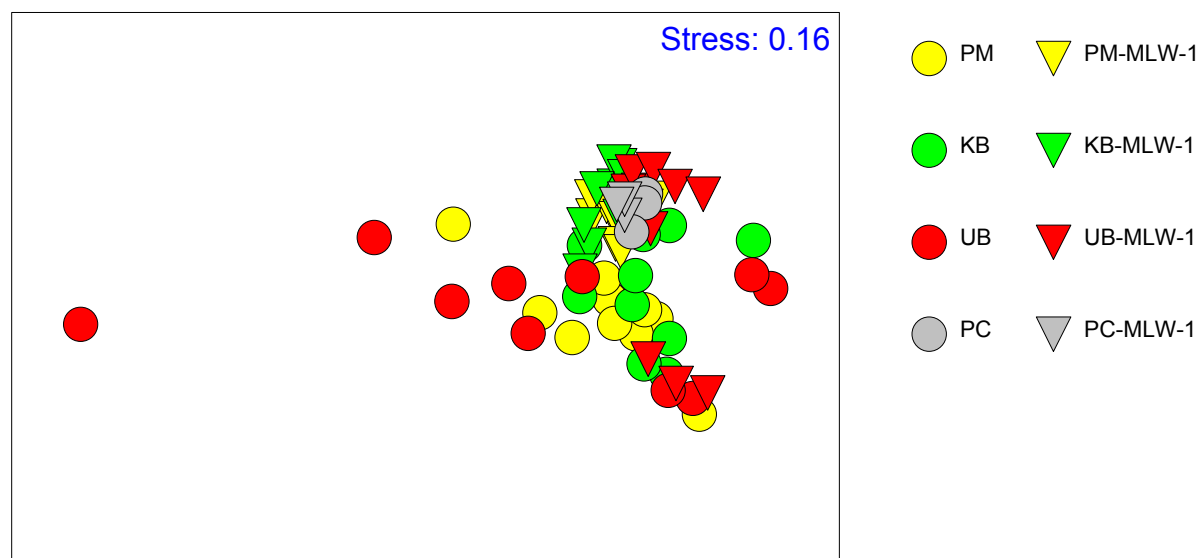


Figure 13. Non-metric dimensional scaling (MDS) results for September 2002 benthic sampling. Circles indicate MLW samples and inverted triangles indicate MLW-1m. Yellow = Port Monmouth, Green = Keansburg, Red = Union Beach, Grey = Point Comfort.

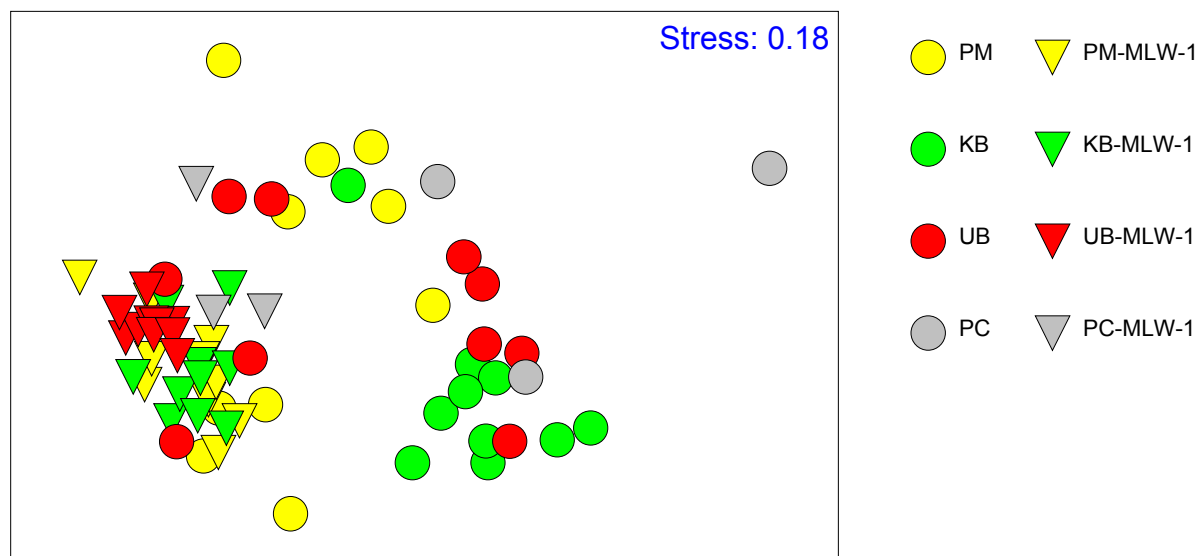


Figure 14. Non-metric dimensional scaling (MDS) results for June 2003 benthic sampling. Circles indicate MLW samples and inverted triangles indicate MLW-1m samples. Yellow = Port Monmouth, Green = Keansburg, Red = Union Beach, Grey = Point Comfort.

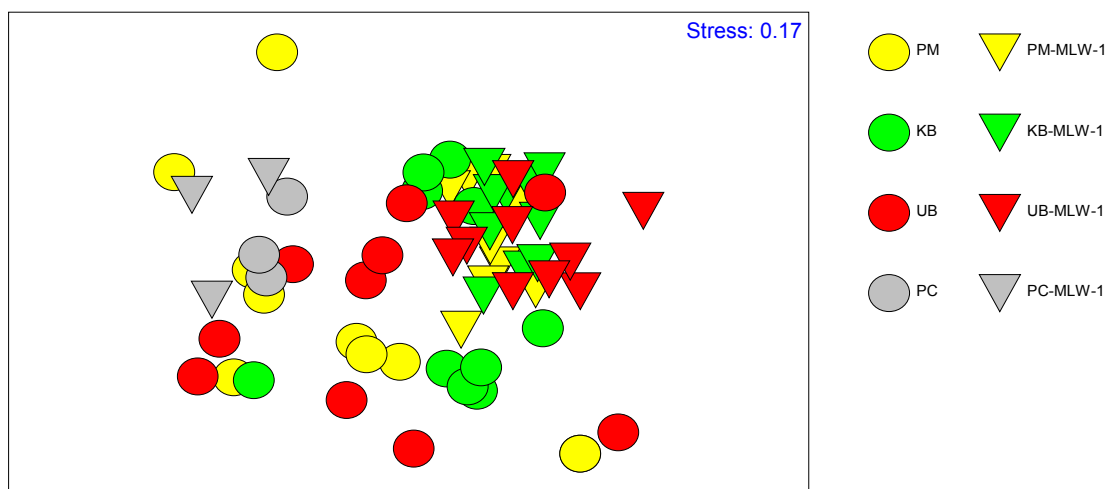


Figure 15. Non-metric dimensional scaling (MDS) results for September 2003 benthic sampling. Circles indicate Mean Low Water (MLW) samples and inverted triangles indicate MLW-1m samples. Yellow = Port Monmouth, Green = Keansburg, Red = Union Beach, Grey = Point Comfort.

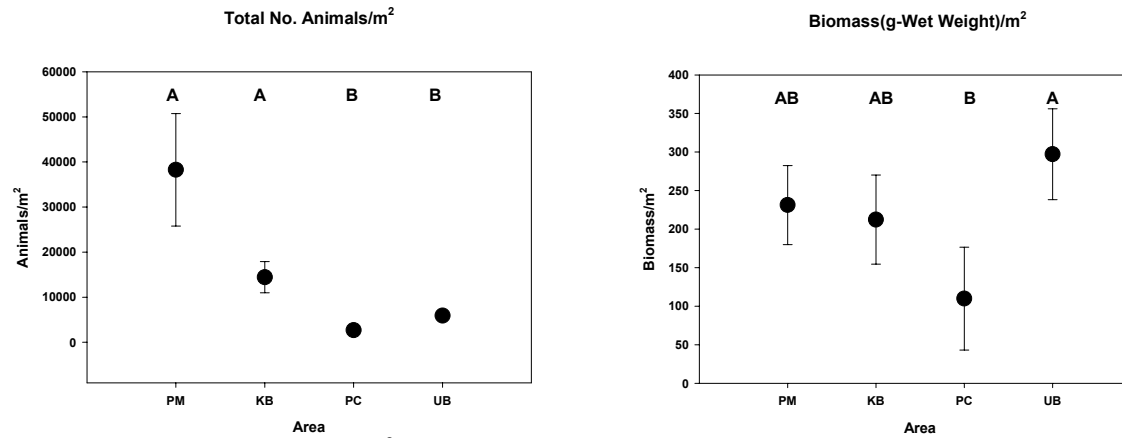


Figure 16. Numerical abundances (Animals/m²) and biomass (g/m²) for Raritan Bay intertidal infauna by area. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

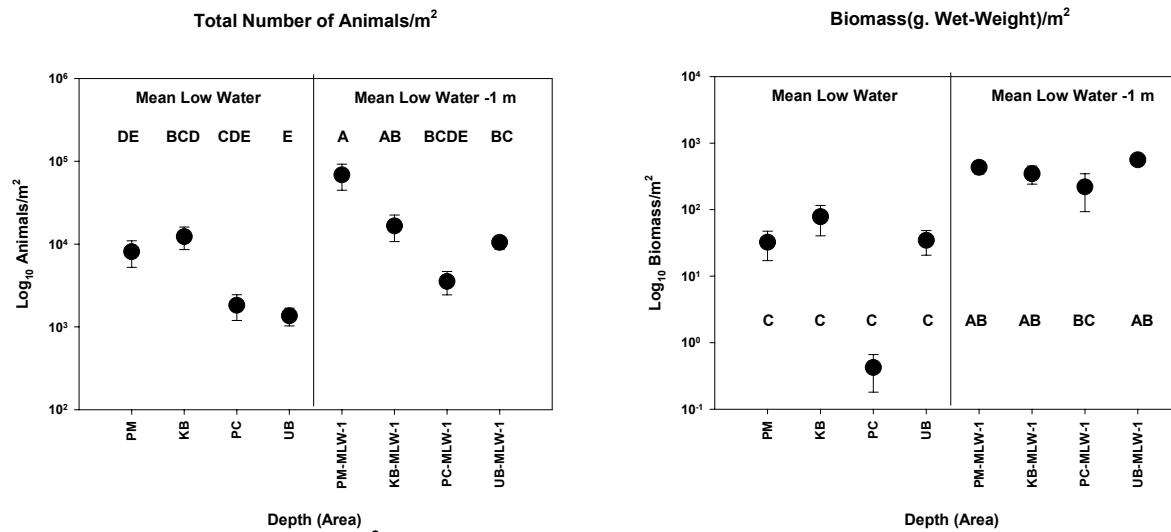


Figure 17. Numerical abundances (Animals/m²) and biomass (g/m²) for Raritan Bay intertidal infauna by depth within area. Mean value (\pm SE). Values with same letter are not significantly different ($p>0.05$)

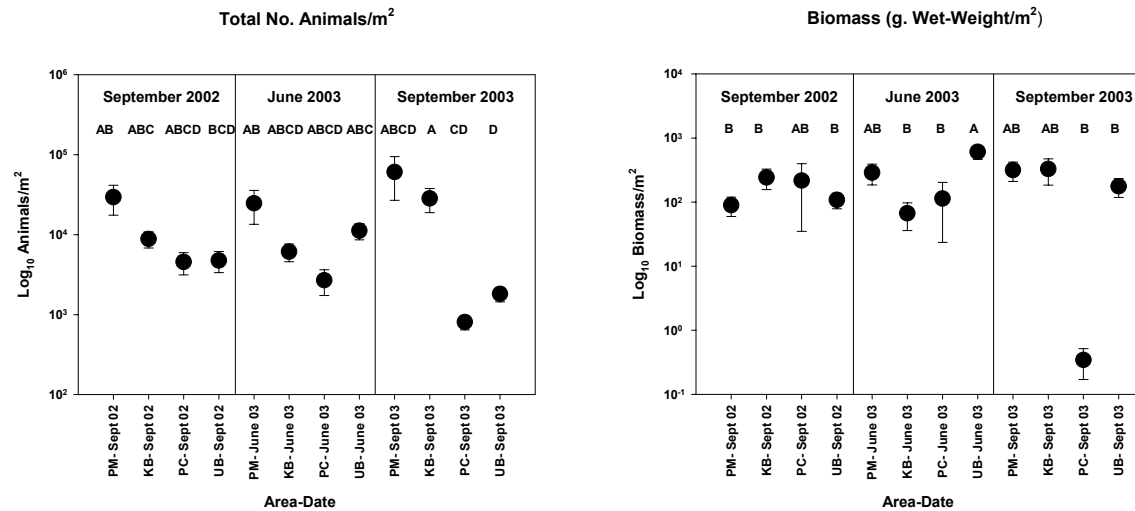


Figure 18. Numerical infaunal abundances (animals/m²) and biomass (g/m²) for Raritan Bay intertidal infauna by area and date. Mean value (\pm SE). Values with same letter are not significantly different ($p > 0.05$)

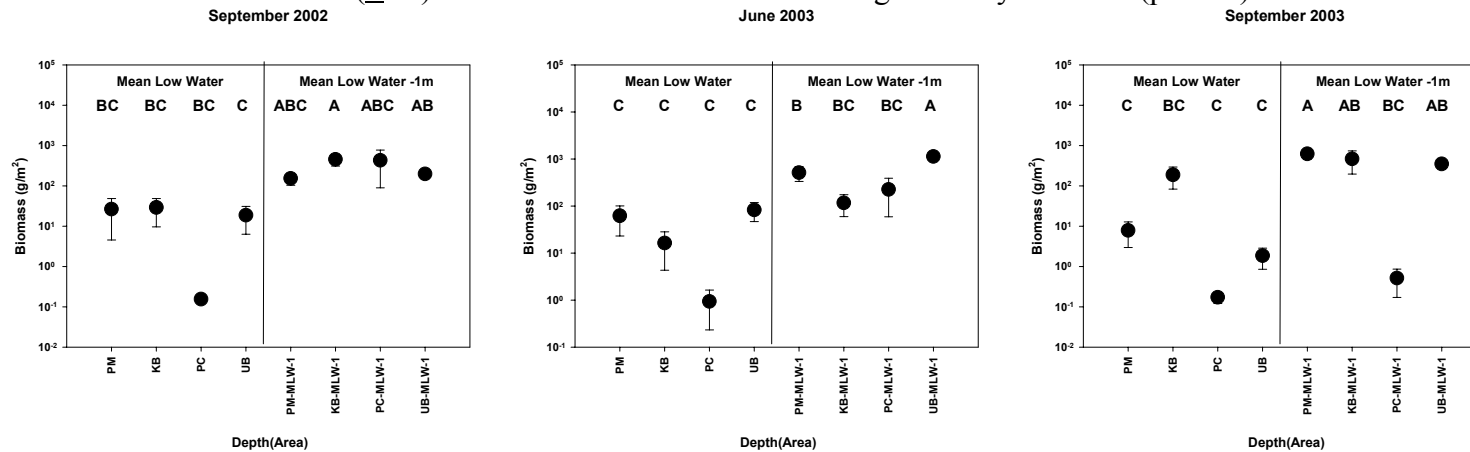


Figure 19. Total infaunal biomass (g./m²) by depth (area) by date. Mean value (\pm SE) Values with same letter are not significantly different ($p > 0.05$).

September 2002

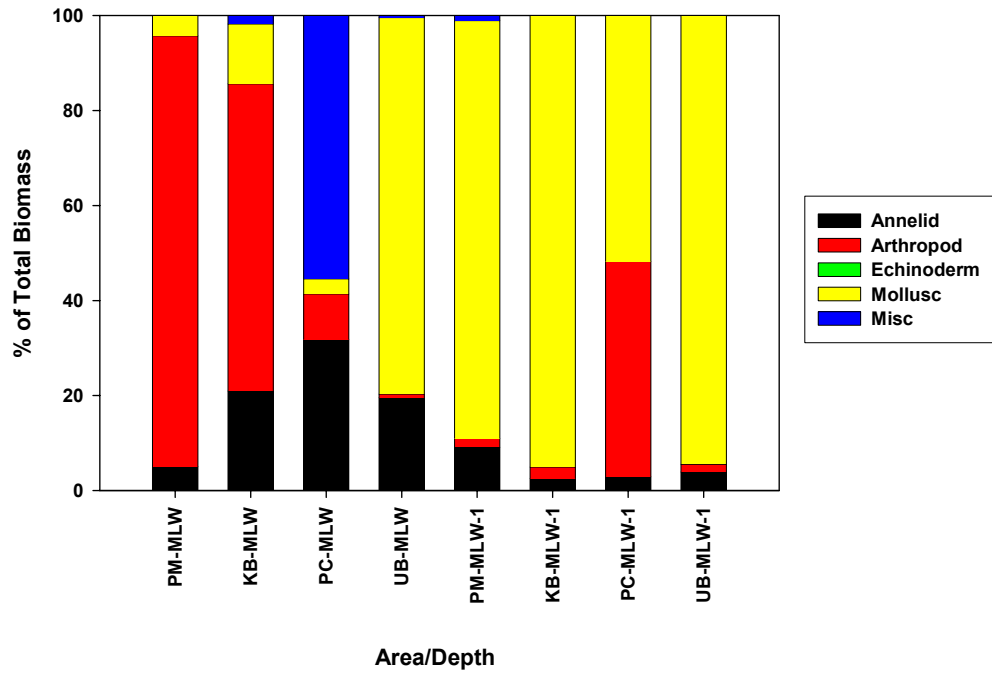


Figure 20. Infaunal biomass composition (% of total) for September 2002.

June 2003

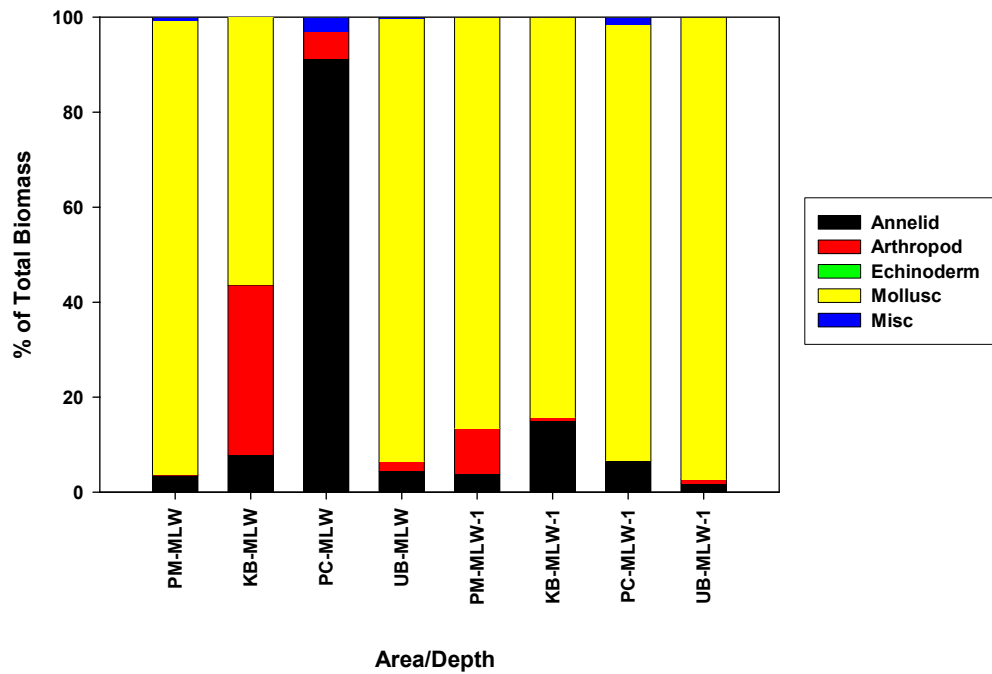


Figure 21. Infaunal biomass composition (% of total) for June 2003

September 2003

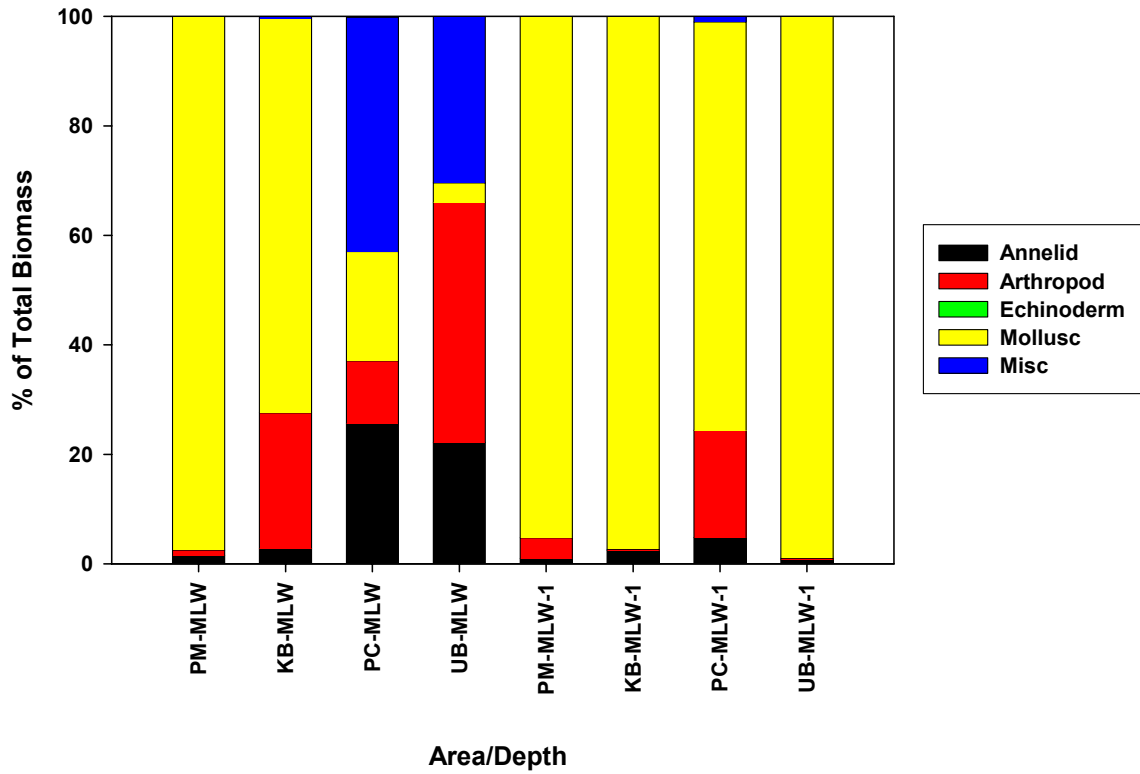


Figure 22. Infaunal biomass composition (% of total) for September 2003.

Table 1. Summary water quality parameters. Temp. = temperature, ppt = parts per thousand, DO = Dissolved oxygen, % Sat = % saturation, NTU = nephelometry units.

Area	Date	Temp. (°C)	Salinity (ppt)	DO (mg/l)	DO (%Sat.)	Turbidity (NTU)	pH
Port Monmouth	September 5-6, 2002	22.69	23.1	4.1	54.85	26.7	7.55
Keansburg	September 5-6, 2002	23.73	22.9	3.5	48.02	12.3	7.46
Union Beach	September 5-6, 2002	21.55	22.6	4.3	56.49	31.9	7.53
Port Monmouth	June 25-26, 2003	23.17	13.3	2.7	33.68	2.0	8.52
Keansburg	June 25-26, 2003	21.70	16.6	2.8	35.14	19.5	8.64
Port Monmouth	September 9-10, 2003	21.10	24.4	9.6	125.57	80.1	8.85
Union Beach	September 9-10, 2003	21.82	21.9	9.4	122.23	281.5	8.34

Table 2. Summary analysis of variance (ANOVA) results

Sediment Mean Grain Size (um) (4th-Root Transformed)				
Source	DF	Sum of Squares	F Ratio	Prob > F
Area	3	22.343	14.260	<.0001
Depth[Area]	4	49.620	23.752	<.0001
Date	2	5.257	5.033	0.0075
Area*Date	6	2.791	0.891	0.5030
Depth*Date[Area]	8	6.792	1.626	0.1206
Error	173	90.355		
Sediment Sorting Coefficient (4th-Root Transformed)				
Source	DF	Sum of Squares	F Ratio	Prob > F
Area	3	0.175	3.539	0.0159
Depth[Area]	4	0.222	3.365	0.0111
Date	2	2.344	71.184	<.0001
Area*Date	6	0.134	1.353	0.2364
Depth*Date[Area]	8	0.498	3.779	0.0004
Error	173	2.848		
Sediment Organic Content (Square-Root Transformed)				
Source	DF	Sum of Squares	F Ratio	Prob > F
Area	3	2.775	4.669	0.0041
Depth[Area]	4	0.907	1.144	0.3395
Date	1	1.843	9.300	0.0028
Area*Date	3	2.913	4.901	0.0030
Depth*Date[Area]	4	3.746	4.726	0.0014
Error	116	22.984		
Infaunal Abundance/m² (Log₁₀ Transformed)				
Source	DF	Sum of Squares	F Ratio	Prob > F
Area	3	10.948	9.074	<.0001
Depth[Area]	4	35.264	21.920	<.0001
Date	2	2.374	2.952	0.0549
Area*Date	6	10.430	4.322	0.0004
Depth*Date[Area]	8	4.530	1.408	0.1961
Error	174	69.980		
Infaunal Biomass/m² (Square-Root Transformed)				
Source	DF	Sum of Squares	F Ratio	Prob > F
Area	3	655.295	3.282	0.0223
Depth[Area]	4	9274.619	34.833	<.0001
Date	2	208.703	1.568	0.2115
Area*Date	6	2552.697	6.392	<.0001
Depth*Date[Area]	8	1540.094	2.892	0.0047
Error	174	11582.271		

Table 3. Total abundance (total numbers of animals) of dominant taxa by area, depth, and date.

Taxon	September 2002				June 2003				September 2003																	
	MLW		MLW-1		MLW		MLW-1		MLW		MLW-1		MLW		MLW-1		MLW		MLW-1		MLW		MLW-1			
	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB	Total	%
<i>Gemma gemma</i>	137	215	2	5	5383	31	12	48	65	5	-----	17	2822	35	6	480	1337	1014	-----	3	13241	247	-----	17	25122	53.37
<i>Streblospio benedicti</i>	4	17	-----	-----	185	364	56	280	-----	-----	-----	18	91	3	9	47	-----	118	-----	15	362	1434	-----	96	3099	6.58
<i>Polydora cornuta</i>	-----	1	-----	2	13	44	1	16	20	3	-----	60	770	107	28	70	-----	598	-----	29	279	864	-----	41	2946	6.26
Tubificidae (LPIL)	34	104	-----	5	1087	602	112	213	9	-----	1	16	303	22	7	351	2	1	1	3	37	14	-----	-----	2924	6.21
<i>Tubificoides heterochaetus</i>	-----	-----	-----	-----	-----	-----	-----	-----	54	3	-----	52	434	223	6	576	-----	10	1	1	191	377	-----	3	1931	4.10
Rhynchocoela (LPIL)	81	87	42	40	3	2	-----	-----	18	2	5	4	2	-----	4	1	25	1163	12	19	3	-----	2	4	1519	3.23
Oligochaeta (LPIL)	-----	-----	-----	-----	-----	-----	-----	-----	543	715	78	24	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1360	2.89
<i>Sabellaria vulgaris</i>	16	5	-----	14	97	82	-----	16	-----	-----	-----	-----	132	2	1	10	-----	373	3	1	54	242	-----	9	1057	2.25
<i>Ilyanassa obsoleta</i>	-----	-----	-----	3	15	41	8	48	6	1	-----	12	49	11	14	275	-----	11	-----	-----	47	40	-----	77	658	1.40
<i>Mediomastus (LPIL)</i>	1	6	-----	-----	48	122	27	91	3	2	1	5	19	9	5	65	-----	7	-----	4	32	186	1	11	645	1.37
<i>Heteromastus filiformis</i>	1	27	1	4	28	29	6	212	-----	-----	-----	4	17	13	2	57	-----	9	-----	4	79	24	-----	46	563	1.20
<i>Streptosyllis pettiboneae</i>	2	-----	-----	-----	10	1	-----	-----	2	-----	-----	4	106	17	2	337	-----	-----	-----	-----	-----	-----	-----	-----	481	1.02
<i>Protodriloides (LPIL)</i>	20	-----	-----	25	-----	-----	-----	-----	366	22	12	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	446	0.95

Table 4. Summary relative abundances (% of numbers of animals) of dominant taxa.

Taxon	Grand Total	PM	KB	PC	UB	MLW	MLW-1
<i>Gemma gemma</i>	53.4	75.8	13.5	3.1	12.2	31.7	58.4
<i>Streblospio benedicti</i>	6.6	2.1	16.9	10.2	9.7	1.9	7.7
<i>Polydora cornuta</i>	6.3	3.6	14.1	4.6	4.7	8.1	5.8
Tubificidae (LPIL)	6.2	4.9	6.5	19.0	12.5	2.0	7.2
<i>Tubificoides heterochaetus</i>	4.1	2.2	5.4	1.1	13.5	1.4	4.7
Enchytraeidae (LPIL)	3.2	*	11.0	10.2	1.5	17.0	*
Oligochaeta (LPIL)	2.9	1.8	6.3	12.2	*	15.4	-----
<i>Sabellaria vulgaris</i>	2.2	1.0	6.2	*	1.1	4.7	1.7
<i>Ilyanassa obsoleta</i>	1.4	*	*	3.5	8.9	*	1.6
<i>Mediomastus (LPIL)</i>	1.4	*	2.9	5.3	3.8	*	1.6
<i>Heteromastus filiformis</i>	1.2	*	*	1.4	7.0	*	1.3
<i>Streptosyllis pettiboneae</i>	1.0	*	*	*	7.3	*	1.2
<i>Protodriloides (LPIL)</i>	1.0	1.3	*	1.9	*	5.1	-----
<i>Paraonis fulgens</i>	*	*	1.3	*	*	1.9	*
<i>Microphthalmus (LPIL)</i>	*	*	*	3.8	*	1.7	*
<i>Polygordius (LPIL)</i>	*	*	*	2.8	*	1.1	*
Lumbriculidae (LPIL)	*	*	2.1	1.9	*	*	*
<i>Mulinia lateralis</i>	*	*	1.6	3.9	*	*	*
Phyllodocidae (LPIL)	*	*	1.2	*	1.7	*	*
<i>Hypereteone fauchaldi</i>	*	*	1.0	1.1	1.5	*	*
<i>Mediomastus ambiseta</i>	*	*	*	2.4	1.7	*	*
Spionidae (LPIL)	*	*	*	1.1	*	*	*
<i>Leitoscoloplos (LPIL)</i>	*	*	*	1.3	*	*	*

*present but not in abundances >1% of total numbers of animals; ----- absent.

Table 5. Summary analysis of similarity (ANOSIM) results

	September-02		June-03		September-03	
	Area					
	R	% p	R	% p	R	% p
Global Test	0.161	0.1	0.359	0.1	0.383	0.1
Pairwise Tests						
PM, KB	0.11	2.2	0.348	0.1	0.267	0.1
PM, UB	0.266	0.1	0.226	0.1	0.345	0.1
PM, PC	0.265	3.9	0.420	0.2	0.471	0.7
KB, UB	0.194	0.1	0.407	0.1	0.358	0.1
KB, PC	-0.133	83.8	0.425	0.7	0.729	0.1
UB, PC	-0.089	74.0	0.615	0.2	0.609	0.1
	Depth					
Global Test	0.392	0.1	0.560	0.1	0.436	0.1
	Area By Depth					
Global Test	0.248	0.1	0.481	0.1	0.437	0.1
Pairwise Tests						
PM, PM-MLW-1	0.582	0.1	0.273	0.2	0.602	0.1
PM, KB	-0.013	55.7	0.515	0.1	0.277	0.5
PM, KB-MLW-1	0.574	0.1	0.274	0.5	0.680	0.1
PM, UB	0.208	1.5	0.087	12.6	0.189	1.3
PM, UB-MLW-1	0.229	1.6	0.463	0.1	0.658	0.1
PM, PC	0.328	7.3	0.380	1.4	-0.057	57.0
PM, PC-MLW-1	0.349	5.9	-0.217	93.4	-0.142	77.3
PM-MLW-1, KB	0.443	0.1	0.859	0.1	0.189	3.6
PM-MLW-1, KB-MLW-1	0.233	1.4	0.182	0.9	0.256	0.3
PM-MLW-1, UB	0.446	0.1	0.405	0.1	0.493	0.2
PM-MLW-1, UB-MLW-1	0.324	0.1	0.365	0.2	0.500	0.1
PM-MLW-1, PC	0.382	0.3	0.999	0.3	1.000	0.3
PM-MLW-1, PC-MLW-1	0.201	10.5	0.460	2.4	0.999	0.3
KB, KB-MLW-1	0.400	0.2	0.871	0.1	0.305	0.7
KB, UB	0.191	0.6	0.249	1.1	0.214	1.1
KB, UB-MLW-1	0.117	8.4	0.889	0.1	0.380	0.2
KB, PC	0.007	41.3	0.419	6.3	0.458	1.4
KB, PC-MLW-1	0.029	34.3	0.751	0.7	0.639	0.7
KB-MLW-1, UB	0.468	0.1	0.439	0.1	0.585	0.1
KB-MLW-1, UB-MLW-1	0.197	0.8	0.564	0.1	0.502	0.1
KB-MLW-1, PC	0.094	21.7	1.000	0.3	1.000	0.3
KB-MLW-1, PC-MLW-1	-0.272	96.2	0.432	2.8	1.000	0.3
UB, UB-MLW-1	0.168	3.1	0.524	0.1	0.420	0.1
UB, PC	-0.051	57.7	0.341	2.4	0.218	10.5
UB, PC-MLW-1	-0.028	53.1	-0.008	50.0	0.288	4.9
UB-MLW-1, PC	-0.276	99.3	1.000	0.3	0.989	0.3
UB-MLW-1, PC-MLW-1	-0.127	70.6	0.889	0.3	1.000	0.3
PC, PC-MLW-1	0.852	10.0	0.778	10.0	0.111	20.0

Table 6. Selected results from Ettinger (1996).

	PORT MONMOUTH						KEANSBURG					
	1994			1995			1994			1995		
Abundance (%)	A	B	C	A	B	C	A	B	C	A	B	C
<i>Mya arenaria</i>	44.4	61.5	14.7	28.6	0.5	*	78	52.3	51.6	*	*	*
<i>Heteromastus filiformis</i>	28.8	12.9	7.2	*	*	*	10	13.9	6.6	*	*	*
<i>Leitoscoloplos sp.</i>	4.3	5.8	7.5	*	*	*	*	*	*	*	*	*
<i>Cautleriella killariensis</i>	0.5	1.5	34.2	*	*	*	*	*	*	*	*	*
<i>Gemma gemma</i>	*	0.8	11.6	4.8	56	64.5	0.5	9	1.7	0.2	55	91.6
<i>Paraonis fulgens</i>	*	*	*	14.3	0.5	*	*	*	*	*	*	*
<i>Lyonsia hyalina</i>	*	*	*	14.3	0.2	0.1	*	*	*	*	*	*
<i>Glycera dibranchiata</i>	*	*	*	9.5	0.7	1	*	*	*	*	*	*
<i>Pagurus arcuatus</i>	*	*	*	9.5	0.2	0.2	*	*	*	*	*	*
<i>Streblospio benedicti</i>	*	*	*	*	8.7	0.7	*	*	*	*	*	*
<i>Ilyanassa obsoleta</i>	*	*	*	*	7.5	*	1.8	3.9	13	*	*	*
<i>Neomysis americana</i>	*	*	*	*	6.6	*	*	*	*	*	*	*
<i>Leitoscoloplos fragilis</i>	*	*	*	*	6.4	3.2	*	*	*	*	*	*
<i>Tharyx acutus</i>	*	*	*	*	2.1	19	*	*	*	*	*	*
Enchytraeidae	*	*	*	*	*	*	*	*	*	62.5	*	0.2
<i>Protodriloides sp.</i>	*	*	*	*	*	*	*	*	*	21.3	0.1	0.1
<i>Gammarus lawrencianus</i>	*	*	*	*	*	*	*	*	*	11	29.9	*
<i>Spio setosa</i>	*	*	*	*	*	*	*	*	*	*	*	*
Taxa	30	21	21	9	24	22	37	30	35	21	26	24
Total Animals/m ²	5083	8678	3559	256	5168	11652	6489	6484	3510	4547	5595	8406
Total Biomass (g/m ²)	*	*	*	2.02	55.98	17.3	*	*	*	12.37	229.1	344.4
% Polychaete Biomass	*	*	*	66	4.7	43.7	*	*	*	45.5	1.9	3.5
% Crustacean Biomass	*	*	*	1.8	3.7	4	*	*	*	5.6	4.5	13.1
% Bivalve Biomass	*	*	*	5.4	6.7	25.4	*	*	*		87.2	76.4
% Gastropod Biomass	*	*	*	*	70.8	0.4	*	*	*	41.6	3	0.3
% Nemertean Biomass	*	*	*	26.8	3.8	26.1	*	*	*	6.1	3.3	6.6
% Other Biomass	*	*	*	*	0.4	0.4	*	*	*	1.1	0	0
Samples	18	18	18	18	18	18	52	54	54	44	44	44

Appendix Table 1. Summary sediment characteristics from samples collected in each of the areas by depth and date.

Area	Depth	Date	MGS	SC	SK	KU	Sample Type	Sediment Texture
PM	MLW	Sept02	863.9	3.037	0.370	1.722	Unimodal, Poorly Sorted	Gravelly Sand
PM	MLW	Sept02	447.2	1.703	0.033	0.965	Unimodal, Moderately Sorted	Slightly Gravelly Sand
PM	MLW	Sept02	412.3	1.643	0.076	1.126	Unimodal, Moderately Sorted	Sand
PM	MLW	Sept02	559.8	2.028	-0.062	1.455	Unimodal, Poorly Sorted	Gravelly Sand
PM	MLW	Sept02	315.8	8.190	-0.382	0.757	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept02	1640.2	2.637	0.282	1.651	Unimodal, Poorly Sorted	Sandy Gravel
PM	MLW	Sept02	1332.3	2.619	0.182	1.330	Unimodal, Poorly Sorted	Gravelly Sand
PM	MLW	Sept02	1251.2	1.918	0.176	0.879	Unimodal, Moderately Sorted	Gravelly Sand
PM	MLW	Sept02	951.6	4.884	0.131	1.503	Bimodal, Very Poorly Sorted	Gravelly Sand
PM	MLW	Sept02	437.0	4.764	0.136	1.352	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1m	Sept02	373.5	2.178	-0.205	2.900	Bimodal, Poorly Sorted	Slightly Gravelly Sand
PM	MLW-1m	Sept02	81.41	3.912	0.109	0.728	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1m	Sept02	426.8	1.639	0.078	1.055	Unimodal, Moderately Sorted	Slightly Gravelly Sand
PM	MLW-1m	Sept02	220.7	3.028	-0.589	2.839	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1m	Sept02	234.2	9.980	0.003	0.745	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1m	Sept02	2138.1	6.896	0.558	0.560	Bimodal, Very Poorly Sorted	Sandy Gravel
PM	MLW-1m	Sept02	627.2	5.003	-0.342	0.532	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
PM	MLW-1m	Sept02	401.2	1.683	0.126	1.378	Unimodal, Moderately Sorted	Slightly Gravelly Sand
PM	MLW-1m	Sept02	205.5	3.138	-0.626	2.298	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1m	Sept02	191.5	2.908	-0.702	1.566	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	Sept02	333.6	5.458	-0.035	4.017	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept02	288.5	4.063	-0.330	1.828	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept02	521.9	3.103	0.313	2.173	Unimodal, Poorly Sorted	Gravelly Sand
KB	MLW	Sept02	285.2	2.296	-0.447	2.663	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW	Sept02	235.8	2.904	-0.386	2.210	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	Sept02	427.7	3.053	-0.378	1.478	Bimodal, Poorly Sorted	Gravelly Sand
KB	MLW	Sept02	487.8	2.155	0.031	1.145	Unimodal, Poorly Sorted	Gravelly Sand
KB	MLW	Sept02	348.3	1.557	-0.040	1.396	Unimodal, Moderately Well Sorted	Sand
KB	MLW	Sept02	508.4	2.573	0.168	1.720	Unimodal, Poorly Sorted	Gravelly Sand
KB	MLW	Sept02	612.7	1.931	-0.044	1.862	Unimodal, Moderately Sorted	Gravelly Sand
KB	MLW-1m	Sept02	259.9	2.319	-0.530	1.900	Bimodal, Poorly Sorted	Muddy Sand
KB	MLW-1m	Sept02	112.4	3.830	-0.319	0.810	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1m	Sept02	318.7	1.592	-0.122	1.371	Unimodal, Moderately Well Sorted	Slightly Gravelly Sand
KB	MLW-1m	Sept02	315.2	1.566	-0.137	1.298	Unimodal, Moderately Well Sorted	Sand
KB	MLW-1m	Sept02	303.5	2.320	-0.441	2.887	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1m	Sept02	204.4	2.846	-0.610	1.704	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1m	Sept02	295.4	1.553	-0.232	1.042	Unimodal, Moderately Well Sorted	Slightly Gravelly Sand
KB	MLW-1m	Sept02	270.4	1.804	-0.140	1.108	Unimodal, Moderately Sorted	Slightly Gravelly Sand
KB	MLW-1m	Sept02	153.9	4.702	-0.470	0.820	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1m	Sept02	174.3	1.870	-0.097	1.407	Unimodal, Moderately Sorted	Sand
UB	MLW	Sept02	1424.4	4.283	0.445	0.871	Unimodal, Very Poorly Sorted	Gravelly Sand
UB	MLW	Sept02	479.7	1.766	-0.190	0.883	Unimodal, Moderately Sorted	Slightly Gravelly Sand
UB	MLW	Sept02	544.7	1.918	-0.010	1.062	Unimodal, Moderately Sorted	Slightly Gravelly Sand
UB	MLW	Sept02	512.7	3.154	0.334	1.623	Unimodal, Poorly Sorted	Gravelly Sand
UB	MLW	Sept02	431.5	2.999	0.308	1.311	Unimodal, Poorly Sorted	Gravelly Sand
UB	MLW	Sept02	459.6	4.496	0.497	2.181	Unimodal, Very Poorly Sorted	Gravelly Sand
UB	MLW	Sept02	2779.2	3.378	-0.918	0.308	Bimodal, Poorly Sorted	Sandy Gravel
UB	MLW	Sept02	202.1	2.906	-0.410	1.460	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW	Sept02	690.2	2.910	-0.287	1.869	Bimodal, Poorly Sorted	Gravelly Sand
UB	MLW	Sept02	851.4	2.112	-0.080	1.241	Unimodal, Poorly Sorted	Gravelly Sand
PC	MLW	Sept02	1101.4	1.954	0.058	1.055	Unimodal, Moderately Sorted	Gravelly Sand
PC	MLW	Sept02	886.0	2.376	-0.050	1.264	Unimodal, Poorly Sorted	Gravelly Sand
PC	MLW	Sept02	1205.3	2.194	-0.210	1.323	Unimodal, Poorly Sorted	Gravelly Sand

UB	MLW-1m	Sept02	29.08	3.144	-0.134	1.564	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1m	Sept02	301.6	1.626	-0.140	1.343	Unimodal, Moderately Sorted	Slightly Gravelly Sand
UB	MLW-1m	Sept02	81.84	4.317	0.233	0.837	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1m	Sept02	26.29	2.503	-0.391	1.028	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1m	Sept02	190.5	2.923	-0.621	1.388	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1m	Sept02	184.8	3.565	-0.544	1.513	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1m	Sept02	167.7	4.944	-0.407	1.264	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1m	Sept02	144.3	4.098	-0.556	0.932	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1m	Sept02	232.5	4.441	-0.216	2.479	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW-1m	Sept02	684.0	3.240	0.267	1.166	Unimodal, Poorly Sorted	Gravelly Sand
PC	MLW-1m	Sept02	312.8	1.681	-0.106	1.254	Unimodal, Moderately Sorted	Sand
PC	MLW-1m	Sept02	318.6	1.549	-0.144	1.358	Unimodal, Moderately Well Sorted	Sand
PM	MLW	June03	352.4	2.309	-0.264	1.874	Bimodal, Poorly Sorted	Slightly Gravelly Sand
PM	MLW	June03	521.9	2.629	-0.140	1.912	Bimodal, Poorly Sorted	Gravelly Sand
PM	MLW	June03	353.6	2.216	-0.246	1.752	Bimodal, Poorly Sorted	Slightly Gravelly Sand
PM	MLW	June03	985.4	3.060	0.010	0.342	Trimodal, Poorly Sorted	Sandy Gravel
PM	MLW	June03	125.3	5.099	-0.285	0.808	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW	June03	1533.0	3.769	-0.352	0.788	Bimodal, Poorly Sorted	Sandy Gravel
PM	MLW	June03	1974.3	3.097	-0.341	0.573	Bimodal, Poorly Sorted	Sandy Gravel
PM	MLW	June03	2461.8	3.439	-0.688	0.693	Trimodal, Poorly Sorted	Muddy Sandy Gravel
PM	MLW	June03	1470.7	2.627	-0.867	0.367	Trimodal, Poorly Sorted	Sandy Gravel
PM	MLW	June03	608.7	2.700	-0.109	1.790	Bimodal, Poorly Sorted	Gravelly Sand
PM	MLW-1	June03	467.8	2.278	-0.369	1.755	Bimodal, Poorly Sorted	Slightly Gravelly Sand
PM	MLW-1	June03	319.3	2.486	-0.370	2.566	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	June03	182.1	3.362	-0.649	1.471	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	June03	1581.9	4.367	-0.807	0.604	Bimodal, Very Poorly Sorted	Muddy Sandy Gravel
PM	MLW-1	June03	355.9	5.960	-0.100	1.271	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	June03	576.0	4.934	0.171	1.087	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	June03	373.3	3.965	0.148	2.643	Bimodal, Poorly Sorted	Gravelly Sand
PM	MLW-1	June03	310.0	2.363	-0.409	3.206	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	June03	183.5	3.363	-0.516	1.474	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	June03	274.0	2.001	-0.522	1.986	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW	June03	440.3	2.499	-0.505	1.682	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW	June03	433.8	2.231	-0.266	1.731	Bimodal, Poorly Sorted	Sand
KB	MLW	June03	428.0	1.774	0.022	1.129	Bimodal, Moderately Sorted	Slightly Gravelly Sand
KB	MLW	June03	78.88	2.802	0.246	0.929	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	June03	192.2	2.765	-0.414	0.869	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	June03	714.0	5.486	-0.021	1.158	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	June03	714.3	6.833	-0.296	0.763	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
KB	MLW	June03	767.0	2.642	-0.067	1.266	Bimodal, Poorly Sorted	Gravelly Sand
KB	MLW	June03	224.9	7.255	0.260	0.881	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	June03	215.5	2.844	-0.374	1.609	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	287.0	2.330	-0.438	2.880	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	437.0	2.154	-0.210	1.637	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW-1	June03	286.7	2.090	-0.320	1.921	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW-1	June03	315.9	2.007	-0.367	2.549	Bimodal, Poorly Sorted	Sand
KB	MLW-1	June03	208.3	2.978	-0.556	1.859	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	263.9	2.333	-0.342	1.832	Bimodal, Poorly Sorted	Slightly Gravelly Sand
KB	MLW-1	June03	309.4	1.966	-0.504	3.038	Bimodal, Moderately Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	264.4	2.194	-0.585	2.391	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	187.2	3.460	-0.613	1.119	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	June03	55.83	3.311	0.005	1.608	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW	June03	155.1	9.259	0.314	0.410	Unimodal, Very Poorly Sorted	Gravelly Mud
UB	MLW	June03	368.5	3.242	-0.128	1.936	Bimodal, Poorly Sorted	Gravelly Muddy Sand
UB	MLW	June03	1019.3	3.632	-0.004	1.096	Trimodal, Poorly Sorted	Sandy Gravel
UB	MLW	June03	585.9	3.756	0.139	0.946	Trimodal, Poorly Sorted	Gravelly Sand
UB	MLW	June03	512.5	3.243	0.075	1.278	Trimodal, Poorly Sorted	Gravelly Sand

UB	MLW	June03	806.4	3.353	0.108	1.037	Bimodal, Poorly Sorted	Gravelly Sand
UB	MLW	June03	735.0	3.433	0.029	0.895	Trimodal, Poorly Sorted	Gravelly Sand
UB	MLW	June03	373.8	2.078	-0.205	1.445	Bimodal, Poorly Sorted	Sand
UB	MLW	June03	407.6	1.966	-0.142	1.480	Bimodal, Moderately Sorted	Slightly Gravelly Sand
UB	MLW	June03	436.9	2.053	-0.314	1.271	Bimodal, Poorly Sorted	Slightly Gravelly Sand
UB	MLW-1	June03	698.1	4.508	0.110	0.640	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	June03	271.7	2.060	-0.518	1.881	Bimodal, Poorly Sorted	Slightly Gravelly Sand
UB	MLW-1	June03	173.4	4.844	-0.252	1.331	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	June03	333.7	3.131	-0.195	2.395	Bimodal, Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	June03	298.1	2.534	-0.271	1.471	Bimodal, Poorly Sorted	Slightly Gravelly Sand
UB	MLW-1	June03	426.9	5.027	-0.351	0.645	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
UB	MLW-1	June03	23.93	3.236	-0.201	1.184	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	June03	32.65	4.870	0.028	1.219	Unimodal, Very Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	June03	60.90	5.109	0.123	0.804	Unimodal, Very Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	June03	353.5	2.332	-0.298	2.488	Bimodal, Poorly Sorted	Slightly Gravelly Sand
PC	MLW	June03	1712.5	2.603	0.062	1.101	Bimodal, Poorly Sorted	Sandy Gravel
PC	MLW	June03	1595.1	2.087	-1.060	0.325	Bimodal, Poorly Sorted	Sandy Gravel
PC	MLW	June03	1301.7	3.319	0.070	0.542	Trimodal, Poorly Sorted	Sandy Gravel
PC	MLW-1	June03	836.7	4.720	0.206	0.631	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW-1	June03	108.5	8.372	0.405	1.317	Unimodal, Very Poorly Sorted	Gravelly Mud
PC	MLW-1	June03	25.35	2.616	-0.445	0.933	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
PM	MLW	Sept03	543.5	7.003	-0.419	1.631	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	470.3	7.990	-0.445	1.876	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	292.9	7.287	-0.540	0.972	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	188.4	6.253	-0.571	0.868	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW	Sept03	288.4	6.743	-0.490	0.884	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	678.3	8.733	-0.502	1.162	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
PM	MLW	Sept03	765.1	8.374	-0.530	1.261	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
PM	MLW	Sept03	297.5	7.919	-0.539	0.884	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	308.9	7.845	-0.492	0.910	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW	Sept03	416.5	10.18	-0.457	0.837	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	176.4	6.913	-0.407	0.930	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	125.5	4.574	-0.726	0.812	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	Sept03	260.3	10.22	-0.136	1.086	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	188.4	7.336	-0.365	1.036	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	573.9	7.254	-0.883	0.476	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
PM	MLW-1	Sept03	199.4	9.459	-0.161	1.109	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	237.3	9.573	-0.198	1.018	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	137.4	6.262	-0.407	1.076	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PM	MLW-1	Sept03	111.7	5.917	-0.375	0.981	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
PM	MLW-1	Sept03	134.5	4.388	-0.757	0.844	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	Sept03	803.1	7.468	-0.524	1.388	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
KB	MLW	Sept03	567.2	9.178	-0.325	1.395	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
KB	MLW	Sept03	506.9	8.656	-0.314	1.319	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept03	668.4	8.441	-0.377	1.007	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept03	167.5	4.592	-0.624	1.036	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	Sept03	137.0	4.642	-0.622	0.919	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW	Sept03	219.4	6.845	-0.328	1.164	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept03	149.8	7.025	-0.322	1.268	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW	Sept03	234.0	11.06	0.222	0.645	Unimodal, Very Poorly Sorted	Gravelly Mud
KB	MLW	Sept03	144.6	4.374	-0.683	0.964	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	269.0	8.784	-0.152	1.021	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW-1	Sept03	361.6	7.722	-0.223	0.456	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
KB	MLW-1	Sept03	196.3	4.170	-0.610	1.977	Bimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	146.0	3.947	-0.737	1.011	Bimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	74.68	4.139	0.025	0.829	Unimodal, Very Poorly Sorted	Muddy Sand
KB	MLW-1	Sept03	87.89	7.446	-0.498	0.508	Bimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand

KB	MLW-1	Sept03	139.0	4.172	-0.713	0.864	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	157.2	3.755	-0.628	0.871	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	140.8	4.190	-0.764	0.908	Bimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
KB	MLW-1	Sept03	126.1	4.377	-0.705	0.834	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW	Sept03	378.6	10.07	-0.188	0.729	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	206.3	12.46	0.162	0.850	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	640.3	10.47	-0.567	0.580	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
UB	MLW	Sept03	123.1	5.852	-0.543	0.929	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW	Sept03	467.4	7.316	-0.400	1.254	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	373.0	8.346	-0.401	0.888	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	346.6	7.993	-0.449	0.843	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	493.9	10.18	-0.399	0.797	Unimodal, Very Poorly Sorted	Muddy Sandy Gravel
UB	MLW	Sept03	362.9	8.595	-0.470	0.813	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW	Sept03	321.4	7.084	-0.454	0.881	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	Sept03	88.34	4.807	-0.385	0.763	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1	Sept03	22.12	2.806	-0.340	0.865	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	Sept03	24.76	2.604	-0.373	0.972	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	Sept03	133.3	4.206	-0.698	0.880	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1	Sept03	23.76	3.004	-0.251	1.090	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	Sept03	164.4	5.858	-0.390	1.517	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	Sept03	276.2	6.401	-0.447	0.941	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
UB	MLW-1	Sept03	128.9	4.342	-0.733	0.793	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
UB	MLW-1	Sept03	22.49	2.748	-0.322	0.865	Unimodal, Poorly Sorted	Slightly Gravelly Sandy Mud
UB	MLW-1	Sept03	133.3	5.914	-0.501	0.995	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW	Sept03	640.4	7.477	-0.356	1.546	Bimodal, Very Poorly Sorted	Muddy Sandy Gravel
PC	MLW	Sept03	824.8	4.595	-0.193	2.411	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW	Sept03	584.4	6.945	-0.119	0.892	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW-1	Sept03	330.3	4.652	-0.458	1.763	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand
PC	MLW-1	Sept03	1108.3	4.572	-0.346	1.703	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand
PC	MLW-1	Sept03	688.1	4.237	-0.255	2.047	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand

Appendix Table 2. Total number of animals collected in each of the areas by depth and date.

	September 2002								June 2003							
	MLW				MLW-1				MLW				MLW-1			
Taxon	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB	PM	KB	PC	UB
<i>Gemma gemma</i>	137	215	2	5	5383	31	12	48	65	5		17	2822	35	6	480
<i>Streblospio benedicti</i>	4	17			185	364	56	280				18	91	3	9	47
<i>Polydora cornuta</i>		1		2	13	44	1	16	20	3		60	770	107	28	70
Tubificidae (LPIL)	34	104		5	1087	602	112	213	9		1	16	303	22	7	351
<i>Tubificoides heterochaetus</i>									54	3		52	434	223	6	576
Rhynchocoela (LPIL)	81	87	42	40	3	2			18	2	5	4	2		4	1
Oligochaeta (LPIL)									543	715	78	24				
<i>Sabellaria vulgaris</i>	16	5		14	97	82		16					132	2	1	10
<i>Ilyanassa obsoleta</i>				3	15	41	8	48	6	1		12	49	11	14	275
<i>Mediomastus</i> (LPIL)	1	6			48	122	27	91	3	2	1	5	19	9	5	65
<i>Heteromastus filiformis</i>	1	27	1	4	28	29	6	212				4	17	13	2	57
<i>Streptosyllis pettiboneae</i>	2				10	1			2			4	106	17	2	337
<i>Protodriloides</i> (LPIL)	20			25					366	22	12	1				
<i>Paraonis fulgens</i>	42	49	2		91	24	1	12	28	11		2	50	9		2
Lumbriculidae (LPIL)		34		1	5	50			8				1	155		
<i>Mulinia lateralis</i>	4			2	23	49	22	3				2				
Phyllodocidae (LPIL)		3			4	21		2	3			4	21	17	1	69
<i>Hypereteone fauchaldi</i>		3			6	28	5	9	2	2	1	6	22	7		53
<i>Mediomastus ambiseta</i>		5			1	54	15	52					1	2		22
<i>Microphthalmus</i> (LPIL)	47	7	16	2	1				66		1	2	2		3	
<i>Spio filicornis</i>					1					1		5	47	50	5	28
Spionidae (LPIL)					1	6	2	6	10	1		4	16	40	5	16
<i>Leitoscoloplos</i> (LPIL)	8	10		11	47	13	8	5	1	3			7			1
<i>Monocorophium tuberculatum</i>						5							21			3
<i>Ampelisca abdita</i>									2	2	3	10	14	1		3
<i>Leitoscoloplos robustus</i>		1	1	4	1	2			7	2		5	26	23	1	26
<i>Caulleriella</i> sp. J					58	4		1					42	2		3
<i>Polygordius</i> (LPIL)									2	3						
<i>Mya arenaria</i>						3			5			6	5	11		18
<i>Unciola serrata</i>	2				3				1				64	4		
<i>Marenzellaria viridis</i>							1	1	6			11	28	14		1
Bivalvia (LPIL)		2			23	36	2	1					1			
<i>Streptosyllis arenae</i>					12			12				2	4	5		22
<i>Scolecopsis texana</i>		2			16	16	1	9					1	3		7
<i>Crepidula fornicata</i>	3				8	9		3					5			
<i>Neomysis americana</i>		5		1		1	1		1			3	12	16		9
Enchytraeidae (LPIL)	46															
<i>Gammarus mucronatus</i>									5			1	14			23
<i>Hypereteone</i> (LPIL)					15	10	2	12					3			
<i>Nereis succinea</i>					1			2	1				3			1
Cirratulidae (LPIL)					9	5	1	5					5		1	8
<i>Tharyx acutus</i>		6			6	1	1	5					2	1		4
<i>Pagurus</i> (LPIL)	1			1	6	1		2					4			
<i>Rictaxis punctostriatus</i>																
<i>Oxyurostylis smithi</i>					4	4		1	1				1	4		9
<i>Eupleura caudata</i>		1			12				1				9	1		
<i>Edotea triloba</i>	3	1	1	1	3			1				2	4	1		6
<i>Drilonereis longa</i>		1			2	6		5	2				1	3	2	4
Mactridae (LPIL)	3	2			7	13										
<i>Tellina agilis</i>				1	6	2		2	1				7	3		

<i>Ameroculodes edwardsi</i>												3		2		18
<i>Glycera dibranchiata</i>		1		1	2	5	2	1		1				3	1	6
<i>Pectinaria gouldii</i>					2	5	1									
<i>Spio setosa</i>		1			2	3		14								
<i>Eumida sanguinea</i>	1					1							14			
Paraonidae (LPIL)					1				7	2		1	2	2		2
<i>Nereis (LPIL)</i>	1				1			1								
<i>Ampelisca (LPIL)</i>	1				3	2	1	2	4							
Corophiidae (LPIL)	2	3			4	1		2								
Lineidae (LPIL)					1		1					3	1		4	
<i>Melita nitida</i>													10			1
<i>Microphthalmus hartmanae</i>									12							
<i>Limulus polyphemus</i>																
<i>Monocorophium (LPIL)</i>					8			2								
Sphaeromatidae (LPIL)																
<i>Gammarus (LPIL)</i>		1		2		1				1		4				
<i>Lyonsia hyalina</i>	1				1	4										
Capitellidae (LPIL)								4								
<i>Dyspanopeus sayi</i>					1								1			1
<i>Eobrolgus spinosus</i>	1				4	1		1								
<i>Microphthalmus aberrans</i>									7							
Turbellaria (LPIL)						1					1	1				1
<i>Urosalpinx cinerea</i>					3	1							1			
Mysidae (LPIL)		1											3	1		1
<i>Nereis acuminata</i>						1		1						1		
<i>Odostomia (LPIL)</i>																2
<i>Ovalipes ocellatus</i>		2					1						1			
<i>Scolecopsis (LPIL)</i>					4	1		1								
<i>Cyathura burbancki</i>																5
<i>Gammarus annulatus</i>	1											1				2
<i>Glycera americana</i>												1	1	1		1
<i>Ilyanassa trivittata</i>						4			1							
<i>Pagurus longicarpus</i>	1					2		1								1
<i>Parasterope pollex</i>								1				2				
<i>Podarkeopsis levifuscina</i>								4	1							
Xanthidae (LPIL)					4			1								
<i>Crangon septemspinosa</i>						1				2		1				
Gastropoda (LPIL)	1	1		1												
<i>Pagurus acadianus</i>																
<i>Paracaprella tenuis</i>					1			3								
<i>Spio (LPIL)</i>		1			2			1								
<i>Unciola (LPIL)</i>					1			1					2			
<i>Chiridotea tuftsi</i>										1						
<i>Erichsonella filiformis</i>					1								1			
Melitidae (LPIL)	1				1	1										
<i>Microphthalmus szcelkowi</i>			2			1										
<i>Odostomia seminuda</i>					3											
<i>Paraonis (LPIL)</i>		1				1	1									
Tellinidae (LPIL)						1		2								
<i>Almyracuma proximoculi</i>										1				1		
Amphipoda (LPIL)									2							
<i>Ampithoe valida</i>																2
<i>Autolytus (LPIL)</i>	1							1								
<i>Corbula contracta</i>					2											
<i>Glycera (LPIL)</i>					1											
<i>Glycera robusta</i>																
<i>Glycera sp. D</i>	1				1											
<i>Lysianopsis alba</i>					1			1								

<i>Mytilus edulis</i>								2								
<i>Panopeus herbstii</i>						1		1								
<i>Paracereis caudata</i>			1	1												
<i>Petricola pholadiformis</i>		2														
<i>Photis (LPIL)</i>											2					
<i>Phoxocephalus holbolli</i>												2				
<i>Pseudoleptocuma minor</i>																
<i>Rhepoxynius hudsoni</i>												2				
<i>Sphaeroma (LPIL)</i>	2															
<i>Synidotea laticauda</i>																
<i>Ampelisca vadorum</i>					1											
<i>Aricidea taylori</i>												1				
Ascidacea (LPIL)																
<i>Caecum pulchellum</i>										1						
<i>Callinectes similis</i>								1								
<i>Calliopius laeviusculus</i>															1	
Calypttraeidae (LPIL)				1												
<i>Corophium (LPIL)</i>																
<i>Corophium insidiosum</i>											1					
<i>Crepidula (LPIL)</i>																
Decapoda (LPIL)										1						
Diastylidae (LPIL)																
<i>Diopatra cuprea</i>								1								
<i>Dipolydora commensalis</i>		1														
<i>Emerita talpoida</i>	1															
<i>Eurypanopeus depressus</i>	1															
Glyceridae (LPIL)																
<i>Glycera sp. E</i>					1											
Hesionidae (LPIL)		1														
Isacidae (LPIL)																
Melita (LPIL)												1				
<i>Monoculodes (LPIL)</i>								1								
Mytilidae (LPIL)																
<i>Phyllodoce (LPIL)</i>													1			
<i>Podarke obscura</i>	1															
<i>Polycirrus sp. G</i>																
Polynoidae (LPIL)											1					
Porifera (LPIL)								1								
<i>Prionospio (LPIL)</i>															1	
Pyramidellidae (LPIL)					1											
Serpulidae (LPIL)												1				
<i>Sigambra (LPIL)</i>											1					
<i>Sigambra grubii</i>														1		
<i>Sphaeroma quadridentata</i>	1															
<i>Streptosyllis (LPIL)</i>							1									
<i>Tellina (LPIL)</i>								1								
<i>Unciola irrorata</i>					1											

	September 2003								
	MLW				MLW-1				
Taxon	PM	KB	PC	UB	PM	KB	PC	UB	Grand Total
<i>Gemma gemma</i>	1337	1014		3	13241	247		17	25122
<i>Streblospio benedicti</i>		118		15	362	1434		96	3099
<i>Polydora cornuta</i>		598		29	279	864		41	2946
Tubificidae (LPIL)	2	1	1	3	37	14			2924
<i>Tubificoides heterochaetus</i>		10	1	1	191	377		3	1931
Rhynchocoela (LPIL)	25	1163	12	19	3		2	4	1519
Oligochaeta (LPIL)									1360
<i>Sabellaria vulgaris</i>		373	3	1	54	242		9	1057
<i>Ilyanassa obsoleta</i>		11			47	40		77	658
<i>Mediomastus</i> (LPIL)		7		4	32	186	1	11	645
<i>Heteromastus filiformis</i>		9		4	79	24		46	563
<i>Streptosyllis pettiboneae</i>									481
<i>Protodriloides</i> (LPIL)									446
<i>Paraonis fulgens</i>		30			42	26		11	432
Lumbriculidae (LPIL)			12						266
<i>Mulinia lateralis</i>			3	1		135		21	265
Phyllodocidae (LPIL)		19			8	72		3	247
<i>Hypereteone fauchaldi</i>		14			9	63	1	2	233
<i>Mediomastus ambiseta</i>		11		2	24	31		4	224
<i>Microphthalmus</i> (LPIL)	5	2			2	3	4		163
<i>Spio filicornis</i>									137
Spionidae (LPIL)		1			9	18		1	136
<i>Leitoscoloplos</i> (LPIL)		3			4	2			123
<i>Monocorophium tuberculatum</i>				4	48	40		2	123
<i>Ampelisca abdita</i>		5	1		3	76			120
<i>Leitoscoloplos robustus</i>		10		1	4	2			116
<i>Cautleriella sp. J</i>					1	1			112
<i>Polygordius</i> (LPIL)	77	1	10	2			8		103
<i>Mya arenaria</i>	1	42			1	1			93
<i>Unciola serrata</i>					3	1			78
<i>Marenzelleria viridis</i>		7			3	3			75
Bivalvia (LPIL)		1						1	67
<i>Streptosyllis arenae</i>					7	1		1	66
<i>Scolecopsis texana</i>		1			1	3			60
<i>Crepidula fornicata</i>	2	1		3	13	3		6	56
<i>Neomysis americana</i>									49
Enchytraeidae (LPIL)									46
<i>Gammarus mucronatus</i>					2				45
<i>Hypereteone</i> (LPIL)									42
<i>Nereis succinea</i>	1	12		2	12	4		2	41
Cirratulidae (LPIL)						4		1	39
<i>Tharyx acutus</i>		1				10			37
<i>Pagurus</i> (LPIL)		1		4	6	6		3	35
<i>Rictaxis punctostriatus</i>						34			34
<i>Oxyurostylis smithi</i>					4	4		1	33
<i>Eupleura caudata</i>					6	1			31
<i>Edotea triloba</i>		1		1	2	2		1	30
<i>Drilonereis longa</i>						3			29
Mactridae (LPIL)									25
<i>Tellina agilis</i>					1	2			25

<i>Ameroculodes edwardsi</i>						1			24
<i>Glycera dibranchiata</i>					1				24
<i>Pectinaria gouldii</i>						11		3	22
<i>Spio setosa</i>									20
<i>Eumida sanguinea</i>					1	2			19
Paraonidae (LPIL)									17
<i>Nereis (LPIL)</i>		2			2	6		1	14
<i>Ampelisca (LPIL)</i>									13
Corophiidae (LPIL)									12
Lineidae (LPIL)					1			1	12
<i>Melita nitida</i>					1				12
<i>Microphthalmus hartmanae</i>									12
<i>Limulus polyphemus</i>	3			1		2	5		11
<i>Monocorophium (LPIL)</i>									10
Sphaeromatidae (LPIL)	1				9				10
<i>Gammarus (LPIL)</i>									9
<i>Lyonsia hyalina</i>						2			8
Capitellidae (LPIL)				1		1		1	7
<i>Dyspanopeus sayi</i>					4				7
<i>Eobrolgus spinosus</i>									7
<i>Microphthalmus aberrans</i>									7
Turbellaria (LPIL)					3				7
<i>Urosalpinx cinera</i>					2				7
Mysidae (LPIL)									6
<i>Nereis acuminata</i>					2			1	6
<i>Odostomia (LPIL)</i>				1		3			6
<i>Ovalipes ocellatus</i>		2							6
<i>Scoelelepis (LPIL)</i>									6
<i>Cyathura burbancki</i>									5
<i>Gammarus annulatus</i>					1				5
<i>Glycera americana</i>						1			5
<i>Ilyanassa trivittata</i>									5
<i>Pagurus longicarpus</i>									5
<i>Parasterope pollex</i>						2			5
<i>Podarkeopsis levifusca</i>									5
Xanthidae (LPIL)									5
<i>Crangon septemspinosa</i>									4
Gastropoda (LPIL)								1	4
<i>Pagurus acadianus</i>					4				4
<i>Paracaprella tenuis</i>									4
<i>Spio (LPIL)</i>									4
<i>Unciola (LPIL)</i>									4
<i>Chiridotea tuftsi</i>				1	1				3
<i>Erichsonella filiformis</i>					1				3
Melitidae (LPIL)									3
<i>Microphthalmus szcelkowi</i>									3
<i>Odostomia seminuda</i>									3
<i>Paraonis (LPIL)</i>									3
Tellinidae (LPIL)									3
<i>Almyracuma proximoculi</i>									2
Amphipoda (LPIL)									2
<i>Ampithoe valida</i>									2
<i>Autolytus (LPIL)</i>									2
<i>Corbula contracta</i>									2
<i>Glycera (LPIL)</i>								1	2
<i>Glycera robusta</i>					1	1			2
<i>Glycera sp. D</i>									2
<i>Lysianopsis alba</i>									2

<i>Mytilus edulis</i>									2
<i>Panopeus herbstii</i>									2
<i>Paracereis caudata</i>									2
<i>Petricola pholadiformis</i>									2
<i>Photis (LPIL)</i>									2
<i>Phoxocephalus holbolli</i>									2
<i>Pseudoleptocuma minor</i>		1				1			2
<i>Rhepoxynius hudsoni</i>									2
<i>Sphaeroma (LPIL)</i>									2
<i>Synidotea laticauda</i>				2					2
<i>Ampelisca vadorum</i>									1
<i>Aricidea taylori</i>									1
Ascidacea (LPIL)						1			1
<i>Caecum pulchellum</i>									1
<i>Callinectes similis</i>									1
<i>Calliopius laeviusculus</i>									1
Calypttraeidae (LPIL)									1
<i>Corophium (LPIL)</i>						1			1
<i>Corophium insidiosum</i>									1
<i>Crepidula (LPIL)</i>							1		1
Decapoda (LPIL)									1
Diastylidae (LPIL)					1				1
<i>Diopatra cuprea</i>									1
<i>Dipolydora commensalis</i>									1
<i>Emerita talpoida</i>									1
<i>Eurypanopeus depressus</i>									1
Glyceridae (LPIL)						1			1
<i>Glycera sp. E</i>									1
Hesionidae (LPIL)									1
Isaeidae (LPIL)					1				1
Melita (LPIL)									1
<i>Monoculodes (LPIL)</i>									1
Mytilidae (LPIL)				1					1
<i>Phyllodoce (LPIL)</i>									1
<i>Podarke obscura</i>									1
<i>Polycirrus sp. G</i>	1								1
Polynoidae (LPIL)									1
Porifera (LPIL)									1
<i>Prionospio (LPIL)</i>									1
Pyramidellidae (LPIL)									1
Serpulidae (LPIL)									1
<i>Sigambra (LPIL)</i>									1
<i>Sigambra grubii</i>									1
<i>Sphaeroma quadridentata</i>									1
<i>Streptosyllis (LPIL)</i>									1
<i>Tellina (LPIL)</i>									1
<i>Unciola irrorata</i>									1